

SR 99: ALASKAN WAY VIADUCT & SEAWALL REPLACEMENT PROGRAM

Transportation Discipline Report SR 99: Battery Street Tunnel Fire and Safety Improvements SEPA Checklist

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Transportation Discipline Report SR 99: Battery Street Tunnel Fire and Safety Improvements SEPA CHECKLIST AGREEMENT NO. Y-7888

Submitted to:

Washington State Department of Transportation

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The SR 99: Alaskan Way Viaduct & Seawall Replacement Program is a joint effort between the Federal Highway Administration (FHWA), the Washington State Department of Transportation (WSDOT), and the City of Seattle. To conduct this project, WSDOT contracted with:

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ACRONYMS

ADA	Americans with Disabilities Act
AWV	Alaskan Way Viaduct
AWVSRP	Alaskan Way Viaduct and Seawall Replacement Program
BINMIC	Ballard Interbay Northend Manufacturing and Industrial Center
BST	Battery Street Tunnel
CBD	central business district
CCTV	closed-circuit television
City	City of Seattle
CRF	collision reduction factor
DMS	dynamic message sign
EIS	Environmental Impact Statement
EMAT	Enhancements and Mitigation Advisory Team
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
HOV	high-occupancy vehicle
I-5	Interstate 5
ITS	intelligent transportation systems
LOS	level of service
mph	miles per hour
MTP	Metropolitan Transportation Plan
MVMT	million vehicle miles of travel
NB	northbound
Project	SR 99: Battery Street Tunnel Fire and Safety Improvements
PSRC	Puget Sound Regional Council
SB	southbound
SDOT	Seattle Department of Transportation
SEPA	State Environmental Policy Act
SLU	South Lake Union
SODO	South of Downtown
SR	State Route
TDM	Transportation Demand Management
WSDOT	Washington State Department of Transportation

Chapter 1 INTRODUCTION

State Route (SR) 99 is an important highway facility that serves both local and regional travel demands in the central Puget Sound region. SR 99 passes through downtown Seattle as the Alaskan Way Viaduct (AWV), an elevated double-level structure adjacent to the waterfront.

The Alaskan Way Viaduct and Seawall Replacement Program (AWVSRP) was initiated by the Federal Highway Administration (FHWA), Washington State Department of Transportation (WSDOT), and the City of Seattle (City). This program consists of the Alaskan Way Viaduct and Seawall Replacement along the central waterfront, and the Moving Forward projects, which include column safety, electrical lines relocation, north-end viaduct improvements, south-end viaduct replacement, and transit enhancements. The Moving Forward projects will repair or replace about half of the seismically vulnerable viaduct and will provide safety improvements to the Battery Street Tunnel.

The Battery Street Tunnel is approximately one-half mile in length and carries two lanes of SR 99 in each direction. A center wall separates northbound and southbound lanes. The Battery Street Tunnel ramps connect to SR 99 at the south tunnel portal.

The SR 99: Battery Street Tunnel Fire and Safety Improvements (the Project) would involve upgrading the fire and safety systems in the Battery Street Tunnel, including installing new sprinkler pipes, fire alarm system, air supply fan controls, lighting, intelligent transportation systems (ITS), reinforcing the roof beams, and adding a second emergency exit stairwell in the southbound lanes. Accumulated soot on the tunnel's upper walls and ceiling areas would be removed. The Project also would close the on- and off-ramps just south of the Battery Street Tunnel and convert them to maintenance and emergency access only.

This Transportation Discipline Report is an appendix to the State Environmental Policy Act (SEPA) Checklist for the Project. This report describes transportation conditions associated with the SR 99 corridor through the study area. It also forecasts transportation performance and the effects of construction of improvements to the Battery Street Tunnel and closure of the Battery Street Tunnel ramps.

1.1 Overview

This Transportation Discipline Report includes the following chapters:

- Chapter 2, *Methodology*: describes the methods used to assess the Project in this report.

- Chapter 3, *Studies and Coordination*: describes agency participation in refining the Project.
- Chapter 4, *Affected Environment*: discusses current transportation conditions.
- Chapter 5, *Operational Effects and Benefits*: describes projected traffic and transportation conditions for the Project under forecasted year 2030 conditions. This chapter also discusses conditions for the year of opening, which is currently assumed to be 2011 (Section 5.4).
- Chapter 6, *Transportation Conditions During Construction*: reviews the construction plan and anticipated effects for the Build Alternative.
- Chapter 7, *Indirect and Cumulative Effects*, describes the indirect and cumulative effects during construction and after construction is complete.
- Chapter 8, *References*: lists references consulted in preparing this report.

1.2 Study Area

The study area for this Transportation Discipline Report encompasses the Project's major construction limits on SR 99 from Denny Way (the north portal of the Battery Street Tunnel) to approximately First Avenue (the south portal of the Battery Street Tunnel), and also includes nearby transportation facilities that are closely related to or affected by the SR 99 corridor. The study area encompasses roughly two blocks on either side of SR 99, bordered by Elliott Avenue to the south and Harrison Street to the north. In addition to the Project's major construction, there would be short-term construction related to the sign structures to the north and south of the tunnel portals. This construction would occur outside of the transportation study area but is addressed qualitatively in this document.

1.3 Alternatives Studied

This Transportation Discipline Report analyzes traffic and transportation conditions for the No Build Alternative and the Build Alternative.

1.3.1 No Build Alternative

The No Build Alternative assumes continued operation and maintenance of the existing Battery Street Tunnel and ramps.

This Transportation Discipline Report analyzes traffic and transportation conditions for continued operation of the current Battery Street Tunnel and ramps. The No Build Alternative is referred to in this report as the 2030 Baseline Scenario. Although this scenario is useful for assessing the Build Alternative's performance and effects relative to the facility in place today, it

should be recognized that the current facility was constructed in the 1950s and has not been upgraded since. Its electrical and mechanical systems do not meet modern safety requirements. In addition, a large number of collisions have been associated with the Battery Street Tunnel ramps.

1.3.2 Build Alternative

The Build Alternative would close the ramps just south of the Battery Street Tunnel and convert them to maintenance and emergency access ramps. The Battery Street Tunnel ramps include the northbound on-ramp from Western Avenue and the southbound off-ramp to Western Avenue located immediately adjacent to the Battery Street Tunnel south portal. The Battery Street Tunnel ramps would be closed to the public (though access would be maintained for emergency vehicles and tunnel maintenance) due to physical constraints that prohibit the replacement of these ramps to acceptable standards, and because of the high frequency of collisions associated with these ramps.

The Project would replace and upgrade the Battery Street Tunnel electrical and mechanical systems, install beam seat extensions, and replace tunnel lighting, heat-activated detectors, deluge valves, and fire pull stations. Tunnel lighting would be substantially improved. The Project also includes removing the existing asbestos pipe conduits. In addition, the air supply system would be repaired and the traffic control system and ITS would be upgraded. The Project also would upgrade sign structures and install new sign bridges on SR 99 just north and south of the tunnel. Variable message signs would be installed at the tunnel portals. The vertical clearance in the tunnel would not change.

Proposed ITS and traffic control system improvements to the Battery Street Tunnel include:

- New variable message signs at the north and south portals, in addition to new signs in advance of the tunnel entry.
- New traffic signals at the portals and new warning beacons within the tunnel.
- Additional closed-circuit television within and approaching the tunnel for traffic surveillance, security monitoring, and fire detection.
- New ITS equipment.
- The ability to connect to a 24-hour regional control facility.
- Upgrade and replacement of associated conduits and wiring.
- Installation of new signing and striping.

1.4 Summary of Findings

This report's key findings are summarized here for transportation conditions during the Project's operation and construction.

1.4.1 Operations

After completion of the Project, the following conditions are expected:

- The Project would close the Battery Street Tunnel ramps to and from Western Avenue. These ramps are lightly used and cannot be updated to current geometric standards. They will be closed and used for maintenance and emergency access only.
- With the closure of the Battery Street Tunnel northbound on-ramp and southbound off-ramp at Western Avenue, higher ramp volumes in the South Lake Union area are expected, along with lower volumes in the Battery Street Tunnel in both directions. Volumes at the Denny Way ramps are expected to increase slightly under the Build Alternative.
- The planned closure of the Battery Street Tunnel ramps is expected to reduce collisions on SR 99 substantially (particularly northbound) in the vicinity of the Battery Street Tunnel—a key benefit of the Project.
- Safety improvements to the Battery Street Tunnel, such as improved lighting and installation of new signing and striping, are anticipated to help regulate speeds and increase driver awareness of tunnel conditions.
- The Project is not expected to cause level of service (LOS) conditions at study area intersections to degrade below LOS D during the 2030 AM peak hour. Intersections already operating below LOS D during the AM peak hour with the 2030 Baseline Scenario are not expected to degrade any further under the 2030 Build Alternative.
- Operations at the Western Avenue/Battery Street intersection are expected to improve due to the closure of the southbound Battery Street Tunnel ramp.
- During the year of opening (2011) and 2030 PM peak hour for the Build Alternative, changes in traffic patterns are expected to worsen congested conditions at some study area intersections.
- The Project would provide a benefit for portions of northbound and southbound SR 99 in the study area by reducing traffic volumes and improving LOS and speeds.
- Freight connections to the Ballard Interbay Northend Manufacturing and Industrial Center (BINMIC) will still be provided from the southbound Elliott Avenue on-ramp and northbound Western Avenue off-ramp. An anticipated benefit of the Project would be improved operations compared to the existing facility due to improved ramp configurations and elimination of cross traffic from the Battery Street Tunnel ramps.

- No changes to bicycle and pedestrian facilities are anticipated as part of the Project. With the Battery Street Tunnel ramp closures, the potential for conflicts between pedestrians and bicyclists at the ramps would be reduced.
- The Project would remove approximately 12 spaces of off-street parking that is currently designated as private parking and is not available to the public.

1.4.2 Construction

Given the dynamic nature of construction activities, transportation effects would vary throughout the construction period. Three construction stages were evaluated.

- During Traffic Stage 2, SR 99 is anticipated to be closed through the Battery Street Tunnel during weekday evenings and up to two weekends per month. Detour routes would be identified and signed. However, some drivers are expected to choose unsigned alternate routes. The detour routes for SR 99 through traffic would be more circuitous than the existing SR 99 route through the Battery Street Tunnel.
- Traffic volumes on SR 99 that would be potentially affected by weekday evening closures of the Battery Street Tunnel would amount to approximately 7,000 to 8,000 total vehicles. Compared to average weekday daily traffic of approximately 63,400 vehicles through the Battery Street Tunnel, the evening traffic volumes are a relatively small component of the overall traffic demand. Substantial congestion is not anticipated at the ramp exit points associated with the detours (Denny Way in the southbound direction and Western Avenue and Seneca Street in the northbound direction) during evening closures due to the relatively low evening-period traffic demands and available capacity on downtown arterials.
- Full weekend closures would potentially affect approximately 40,000 to 50,000 vehicles that would typically use SR 99. Weekend traffic congestion at the various ramp exit points for both the northbound and southbound detour routes would be greater than during the evening-based closures due to greater overall demand. More significant peaks would likely occur during midday periods. Similarly, congestion on surface streets would be greater than during evening closures.
- King County Metro bus services using SR 99 would not be directly affected by evening and weekend closures of SR 99 during the construction period since Metro bus routes do not use the Battery Street Tunnel. However, buses may experience more congestion on the Denny

Way ramps and on streets in Belltown when the Battery Street Tunnel is closed.

- Closure of the Battery Street Tunnel during evenings and weekends would help minimize the effect of the closure on trucks and freight because truck volumes peak during the midday and afternoon. Western and Elliott Avenues would remain open throughout the construction period, maintaining a vital freight link.
- Pedestrians and bicyclists would experience minor disruptions during construction. Detour routes would be provided as needed. SR 99 closures and increased traffic on surface streets through Belltown could make it more difficult for pedestrians and bicyclists to cross the street. Bicyclists riding in the street may face increased potential for conflicts with vehicles.
- During construction, 6 on-street parking spaces, 12 off-street parking spaces, and 75 off-street monthly permit spaces would be unavailable. After construction is complete, all but 12 of the off-street spaces would be replaced or restored. Parking restrictions may be necessary along Battery Street due to intermittent construction work on the surface. Battery Street surface work would take one or two lanes and would not close the street. In addition, the streets onto which SR 99 traffic is being detoured (Wall Street and Battery Street) may experience parking restrictions.
- Closure of the Battery Street Tunnel ramps would have an immediate safety benefit. The closure is expected to reduce collisions on SR 99 substantially (particularly northbound) in the vicinity of the Battery Street Tunnel.
- Coordination between WSDOT and the City of Seattle is ongoing to avoid or minimize SR 99 closures during major events such as Bumbershoot, the Northwest Folklife Festival, and stadium events.
- The SR 99/Initial Transit Enhancements and Other Improvements (described in Section 6.3) are progressing. These enhancements and improvements are independent projects that benefit all pending improvements under the AWVSRP. Their goal is to provide investment funding to develop and deliver projects and strategies within areas likely to be affected by construction of the Moving Forward projects. This would facilitate overall travel mobility and keep the system moving during construction.
- Drivers on southbound SR 99 could experience disruptions both through the Battery Street Tunnel and on the viaduct (south of S. King Street) at the same time. For 4 to 5 months in 2011, Battery Street Tunnel closures

could occur at the same time as southbound lane reductions on SR 99 associated with the SR 99: S. Holgate Street to S. King Street Viaduct Replacement Project. However, during these months, the Battery Street Tunnel would only be closed sporadically for painting, systems testing, and project closeout.

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Chapter 2 METHODOLOGY

This chapter summarizes the overall study approach and the techniques and tools used to accomplish the following tasks for the Project:

- Develop transportation data.
- Analyze operational effects of existing and future traffic conditions.
- Assess multimodal transportation system performance.

2.1 Study Approach

The transportation study followed a conventional corridor-level planning analysis approach that built on previous work completed as part of the AWVSRP. Previously completed work included the 2004 Draft Environmental Impact Statement (EIS) (WSDOT et al. 2004), 2006 Supplemental Draft EIS (WSDOT et al. 2006), and preliminary work on the Final EIS. This study's data collection, investigation of existing traffic and transportation system conditions, and assessment of projected future conditions all used previous work as appropriate to minimize rework and maximize previous coordination and collaboration efforts. The roles and performance of general-purpose traffic, transit, freight, and nonmotorized traffic were evaluated.

Chapter 4, *Affected Environment* summarizes existing transportation conditions for SR 99 and other nearby or related transportation facilities. This assessment identifies and describes current transportation system components, computes existing operating conditions, and evaluates a number of transportation-related measures to compare effects and benefits. These measures assess performance in a variety of ways and are grouped by focus (mobility, accessibility, and safety). Traffic data supporting these measures are also organized by focus areas. These focus areas are described in detail in Section 2.5.

To gauge longer-term functionality and performance for the SR 99 corridor and other affected transportation system components, projected year 2030 roadway conditions were estimated. A 2030 Baseline Scenario (also referred to as the No Build Alternative) was developed to represent the current SR 99 configuration under forecasted 2030 traffic conditions. The No Build Alternative assumes continued operation of the existing Battery Street Tunnel and ramps with continued maintenance. This alternative serves as a future basis against which the Build Alternative can be compared. The same performance measures evaluated for existing conditions were again assessed for the 2030 Baseline Scenario.

The Build Alternative was analyzed in the same manner, to determine estimated traffic patterns and system performance under 2030 conditions. This analysis is included in Chapter 5, *Operational Effects and Benefits*.

2.2 Data Collection

This section summarizes data collection activities. Unless otherwise noted, data were collected as part of previous work for the AWVSRP and are being used as applicable in this study.

2.2.1 Current Traffic Volumes and Related Traffic Data

Mainline SR 99 Traffic Counts

Existing traffic volumes were previously collected for SR 99 and arterial streets within the study area. Daily and hourly volume estimates for SR 99 ramps are based on traffic counts conducted annually over a 1-week period by the City of Seattle during 2004 through 2006. The data were analyzed for consistency, and then balanced to formulate the final 2005 traffic estimates used for the AM and PM peak-hour analysis.

Intersection and Arterial Traffic Counts

AM and PM peak-hour turning movement counts were previously collected for most traffic signal-controlled intersections within the study area. Traffic volumes at intersections for which counts were not available were estimated based on counts at adjacent intersections. Most counts were conducted between 2003 and 2005. These data were supplemented by 24-hour traffic counts conducted by the City of Seattle during 2004 through 2006. The data were analyzed for consistency, and then balanced to formulate the final 2005 traffic estimates used for the AM and PM peak-hour analysis.

Quality control was performed on all turning movement counts by comparing volumes to adjacent intersection count volumes. They were also compared to midblock arterial counts, where available, to help identify invalid counts. Intersections with unusual counts that could not be otherwise explained were recounted or adjusted based on adjacent intersection data.

For each intersection, the following data were collected:

- Peak-period (AM and PM) turning movement volumes.
- Peak-period heavy vehicle volumes (for full-size buses and heavy commercial trucks only).
- Peak-period pedestrian crossing volumes.
- Peak-period signal timing data, including cycle lengths and phasing information.
- Intersection sketches (intersection geometry).

- Field notes (anything unusual that occurs during the count, such as emergency vehicles, collisions, or nearby construction).

HOV Volumes

High-occupancy vehicle (HOV) volumes were not specifically collected. This is because the SR 99 corridor does not currently include any HOV facilities within the study area, and the Project does not propose to add HOV facilities.

Nonmotorized Transportation

Pedestrian and bicycle volumes at intersections were collected with the arterial turning movement counts described previously. Supplemental bicycle ridership information was collected from existing sources.

Pedestrian volumes were initially collected in winter and during the PM peak hour. Updated pedestrian volumes were collected by video in August 2006 to capture the higher levels of pedestrian activity in summer and on weekends.

Trucks

Heavy-vehicle volumes were collected during the arterial turning movement counts described previously. These data were supplemented by video surveys of freight traffic on SR 99 conducted in June 2006. Additional information on heavy trucks' use of the SR 99 corridor is summarized in the project memorandum *Updated SR 99 Truck Volumes* (Parsons Brinckerhoff 2006a).

Accidents

The City of Seattle and WSDOT provided SR 99 accident data for 2001 through 2004, which was analyzed in the *SR 99 Battery Street Tunnel Collision Evaluation* (Parsons Brinckerhoff 2006b). Although several years old, these data remain consistent in providing an indication of the location, type, and severity of accidents on SR 99.

Parking

On-street and off-street parking spaces that would be affected by the Project were counted in 2008. The affected spaces included those that would be unavailable throughout the construction period. The spaces that may be restricted for short periods, such as during surface work on Battery Street, were not quantified but are discussed in Section 6.2.2, *Parking Effects*.

To provide context for potential construction worker parking needs, off-street parking data collected in 2006 by the Puget Sound Regional Council (PSRC) were obtained. Data on parking regulations and on-street parking locations in Belltown were acquired from Seattle Department of Transportation (SDOT) and through field observations.

2.2.2 Transit Service

Transit information related to service coverage, frequency, and travel times for buses that use SR 99 was identified through published schedules provided by King County Metro. Transit ridership data were not specifically collected, although modeled transit ridership statistics from the travel demand model can be used to compare relative levels of transit.

2.2.3 Roadway Configuration

The SR 99 alignment and geometric data necessary to conduct traffic operations assessment (e.g., segment length, lanes by segment, lane width, grades, and shoulder width) were taken from mapping information generated for the AWVSRP. Arterial and local roadway configurations were collected from paintline sketches, aerial photographs, and traffic counts and were supplemented by site visits as necessary to determine intersection configurations at study area intersections.

2.2.4 Traffic Speeds

The SR 99 traffic analysis models were calibrated based on observed travel speeds and areas of congestion. Posted speed limits on SR 99 were collected by field observation.

2.3 Traffic Demand Estimates and Forecasts

Existing traffic volumes for this study were compiled from the traffic data described in Section 2.2.1. Traffic forecasts for the year of opening (2011) and year 2030 conditions are based on growth projected by the AWV travel demand model, which is a modified version of PSRC's EMME/2 regional travel forecasting model. Procedures for developing specific volume estimates are summarized in the following subsections.

The AWV travel demand model has been updated since completion of the 2006 Supplemental Draft EIS. The updated model includes improvements in how the model reflects capacity constraints in the road network, reduced sensitivity to parking cost assumptions, updated population and employment estimates, and verification of network components and their attributes.

The reduced sensitivity to parking costs results in more moderate projections of future transit ridership, which corrects an issue identified as a concern in the 2004 Draft EIS. The newly updated model has been used to provide a more detailed analysis of traffic projections for the Project and conditions during the construction period. Development of the model is detailed in the *Updated Travel Forecasting Model Validation Report for Base-Year (2000)* (Parsons Brinckerhoff 2005a).

The model base year (existing conditions) was also updated to reflect 2005 conditions. This effort is documented in the *Addendum to Updated Travel Forecasting Model Validation Report for Base Year (2005)* (Parsons Brinckerhoff 2007a).

2.3.1 2005 Existing Conditions AM and PM Peak-Hour and Daily Traffic Estimates

Mainline SR 99 Traffic Volumes

Existing daily and hourly volume estimates for SR 99 ramps and segments are based on traffic counts that the City of Seattle conducted annually during a 1-week period from 2004 through 2006. The count volumes were adjusted to balance AM and PM peak-hour traffic volumes for all SR 99 ramp, side-street, and mainline locations within the study area. The AM peak hour was selected as 8:00 to 9:00 a.m. The PM peak hour was selected as 5:00 to 6:00 p.m. Review of the traffic volume data indicated that the peak traffic volumes for the SR 99 corridor and other study area facilities generally occur between 7:00 and 9:00 a.m. and 4:00 and 6:00 p.m.

AM and PM Peak-Hour Arterial Volumes

AM and PM peak-hour volume estimates are based on traffic counts for major intersections in the study area, using consistent morning and afternoon peak hours.

2.3.2 2030 Traffic Forecasting

Traffic Forecasting Model

A regional travel demand model was used for this study to support the assessment of future conditions. The AWV model is an enhanced version of the PSRC regional planning model, which operates in the EMME/2 software environment. The regional model reflects assumptions for regional population and employment growth, as defined in PSRC's adopted regional plan, *Destination 2030, the Metropolitan Transportation Plan for the Central Puget Sound Region* (PSRC 2001). The AWV model reflects the most recent PSRC population and employment forecasts, which include additional growth in the South Lake Union area.

Model development and validation is detailed in the *Updated Travel Forecasting Model Validation Report for Base Year (2000)* (Parsons Brinckerhoff 2005a).

The AWV travel demand model was used for the following purposes:

- To estimate changes from existing conditions in regional travel demand resulting from population and employment growth and planned transportation system improvements.
- To identify expected demand and traffic distributions for the Build Alternative.

- To develop peak-hour vehicle volumes for use in detailed operational analyses.

2030 Transportation System Components

The design-year scenarios (2030 Baseline and Build Alternative) presume a consistent set of baseline assumptions for 2030 conditions. These assumptions are reflected in the forecasting and analysis models. The 2030 Baseline transportation system consists of today's highway, street, and transit system components and a limited number of new facilities. Only transportation improvements that are currently identified in adopted regional plans and have a funding commitment toward implementation are included in the future baseline. Other planned or proposed (but unfunded) facilities are not included in the 2030 Baseline model.

The following new transportation system components are included in the 2030 Baseline:

- PSRC four-county EMME/2 assumptions
- Sound Transit Phase I System: Sounder Commuter Rail, Express Bus, and Link Light Rail between the University District and Seattle-Tacoma International (Sea-Tac) Airport
- Existing transit service and various agencies' Six-Year Plans
- Sound Transit Tunnel Closure Project: Third Avenue transit exclusivity (Stewart Street to Yesler Way), Prefontaine Place S. reconfiguration, and the Fourth Avenue S. bus island north of S. Jackson Street
- I-90 HOV reconfiguration (Option R8-A)
- King County Metro Transit blueprint improvements
- King County Transit Now service changes and bus rapid transit (BRT) corridors (called RapidRide)
- SR 99: S. Holgate Street to S. King Street Viaduct Replacement Project
- SR 519 Intermodal Access Project, Phase II
- S. Lander Street Overcrossing
- S. Spokane Street Viaduct Phase 1: Widening from SR 99 to First Avenue S.
- S. Spokane Street Viaduct Phase 3: Fourth Avenue S. Loop Ramp
- Parking cost increases, at a rate of 3 percent annually

2.3.3 2030 Baseline Scenario AM and PM Peak-Hour Traffic Estimates

AM and PM Peak-Hour Volumes on Mainline SR 99

AM and PM peak-hour traffic forecasts for the year 2030 were developed for the SR 99 mainline, ramps, and specified adjacent arterials by applying growth estimates to the existing-year traffic estimates. Growth estimates were derived from EMME/2 model results (primarily daily model results, but peak period results were also used).

To establish traffic volumes for the SR 99 mainline, 2005 and 2030 AWW models were compared to determine a net difference—or growth—in daily volumes between the two time periods, for both the ramp and mainline. Projected growth was added to existing traffic volume counts to estimate 2030 daily volumes. Growth estimates were adjusted as necessary to balance volumes, correct any evident assignment irregularities, and account for differences between observed and modeled existing volumes (calibration).

Daily volumes were translated to hourly volumes, based on the observed existing (2005) ratio of peak-hour volumes to daily traffic volumes for all ramp and segment locations. Further adjustments were made to account for peak spreading (leveling), although these adjustments were modest. Peak-period model forecasts were used to help guide this process.

2030 Peak-Hour Arterial and Local Street Forecasts

Growth rates were applied to existing arterial intersection turning movement counts to establish 2030 Baseline peak-hour traffic volumes. These growth rates were based on an evaluation of sub-area and screenline growth forecasted by the AWW model.

The 25-year growth rates (2005 to 2030) for the South Lake Union area ranged from 15 to 30 percent, and for the downtown and Elliott/Western areas ranged from 5 to 15 percent. Traffic volumes were manually adjusted to balance volumes at arterial/ramp interface areas.

2.3.4 2030 Build Alternative Traffic Estimates

Forecasts for the 2030 Baseline established a basis from which traffic estimates for the Build Alternative could be derived. The 2030 Build Alternative forecasts were developed based on the net modeled differences between the Build Alternative and the 2030 Baseline Scenario. Growth estimates were adjusted as necessary to balance volumes, correct any evident assignment irregularities, and account for differences between observed and modeled existing volumes (calibration).

2.3.5 Year of Opening AM and PM Peak-Hour Traffic Forecasts

The year of opening represents traffic conditions at the end of project construction, shortly after the new facility opens. This includes surface street

improvements associated with the Project. According to the current conceptual construction schedule for the Project, the opening year is assumed to be 2011. Year-of-opening volumes were developed by interpolating between existing conditions and the 2030 Build Alternative estimates. As with the 2030 Build Alternative, manual adjustments were made to account for localized traffic generation and routings expected to take place prior to or within the year of opening timeframe.

2.4 Traffic Operations Analysis

2.4.1 Traffic Simulation and Analysis Models

Mainline Traffic Operations

The traffic simulation model VISSIM was used to assess traffic operating conditions on the SR 99 mainline and ramps. VISSIM is a micro-simulation model that simulates traffic operations on highway and street facilities and reports measures such as speeds and traffic density. The network was developed using existing and proposed project configuration data (e.g., lanes, segment lengths, ramp location, and similar data).

Arterial and Local Street Traffic Operations

Traffic operations at selected intersections in the study area were analyzed using Synchro traffic analysis software. Synchro is a computer program designed for analysis of intersection traffic operations. It also allows optimization of intersection traffic signal timings.

2.5 Transportation Data and Performance Measures

Transportation data and performance measures were evaluated for existing conditions, the 2030 Baseline Scenario, and the Build Alternative. These data characterize the relative differences in performance between the Build Alternative and the 2030 Baseline and establish traffic effects that can be expected. They considered data availability and suitability. The performance measures address the important travel modes operating in the corridor, both currently and in the future. These include:

- Highway/roadway
- Nonmotorized (pedestrian and bicycle)
- Freight (commercial vehicles)

Measures were also identified to evaluate how each alternative influences safety, affects parking, and may affect travel during construction.

Performance measures are grouped by the three primary themes of the Project's purpose and need: mobility, accessibility, and safety.

2.5.1 Mobility

Measures of mobility include travel demand, traffic patterns, and AM and PM peak-hour traffic operations.

Travel Demand and Traffic Patterns

SR 99 Mainline and Ramp Volumes

Peak-period and daily traffic volumes were projected for existing conditions (No Build) and the Build Alternative.

Traffic Operations

SR 99 Mainline Levels of Service and Density

SR 99 mainline LOS and density are measures used to characterize the Project's traffic performance. These measures are derived from analysis using VISSIM traffic simulation software.

LOS is a measure that characterizes the operating conditions perceived by a driver or user of a highway, street, or other transportation facility. Although LOS is a qualitative measure, it is based on quantitative measures such as traffic density, average speed, or average vehicle delay. A range of six LOS designations (from A to F) is defined in the Transportation Research Board's 2000 *Highway Capacity Manual* (HCM) (Transportation Research Board 2000). LOS A represents ideal, uncongested operating conditions, and LOS F designates extremely congested breakdown conditions. LOS B through LOS D designate intermediate operating conditions, and LOS E denotes congested conditions at the point of maximum service rate.

LOS for either freeway segments or multi-lane highway segments is derived from traffic density, as shown in Exhibit 2-1. These density ranges are documented in the 2000 HCM on page 21-3 (*Multilane Highway Methodology*) and page 23-3 (*Freeway Segment Methodology*).

Exhibit 2-1. Level of Service Designations

LOS (Freeway Segment)	Density Range (pcpmpl)
A	0–11
B	> 11–18
C	> 18–26
D	> 26–35
E	> 35–45
F	> 45

Source: Transportation Research Board (2000), pages 21-3 and 23-3.
pcpmpl = passenger car equivalents per mile per lane

Arterial Intersection Performance

AM and PM peak-hour traffic operations on surface streets adjacent to or near SR 99 were assessed using Trafficware Corporation's Synchro traffic analysis software Version 7. Intersection LOS and average vehicle delay are reported for selected key intersections within the study area and are shown in Exhibit 2-2. The selected locations represent intersections that are potentially most affected by proposed project changes to SR 99.

LOS is reported based on the Synchro percentile delay method. This method differs slightly from 2000 HCM methods, but reports LOS using the same average vehicle delay basis. The percentile delay method was selected because it better models actuated signal timings, coordinated signal timings, and highly congested conditions. Additionally, although Synchro (Version 7) can produce LOS results based on the 2000 HCM methods, it does not account for right-turn-on-red maneuvers when doing so, which can understate LOS (i.e., report poorer than actual LOS). The percentile-delay-based LOS results presented in this study do not have this limitation.

Intersection analysis results were used to identify locations on surface streets in the study area where traffic operations are expected to be poor during the AM or PM peak hour. The selection of intersections for evaluation was based on several factors, including proximity to SR 99, location relative to SR 99 ramps, and existing traffic volumes and performance.

2.5.2 Accessibility

Roadway Connectivity and Access

This measure consists of providing qualitative ratings for arterial connections to and from locations where SR 99 currently provides access.

The Build Alternative's connections were identified by movement (e.g., northbound SR 99 to South Lake Union) and evaluated qualitatively as providing "good access," "partial or substandard access," or "no access." These designations reflect the degree of connectivity provided (full access, partial access, or no access); the quality of connections (high-speed/capacity ramp connections, low-speed/capacity ramp connections, or arterial connections); and the type of connection provided (direct connection, short indirect connection, or longer indirect connection requiring extended arterial travel).

Freight Access

The freight measure evaluates the Project's effect on freight and goods movement, and includes a qualitative assessment of the project design's effect on existing truck connections. This includes access to port facilities and the Ballard/Interbay area.

Pedestrian and Bicycle Access

Effects to pedestrian and nonmotorized modes were assessed qualitatively in three ways:

- Accessibility to pedestrian and bicycle facilities along Elliott and Western Avenues through the study area.
- Potential effects of ramp operations on pedestrians.
- The effect of changes in traffic volumes and distribution on pedestrians and bicycles.

2.5.3 Safety

Safety measures involve identifying major design elements, including facility type, lane widths, geometric configuration, and potential vehicle and pedestrian conflict locations.

The AWVSRP's *SR 99 Collision Analysis* report (Parsons Brinckerhoff 2005b) details the collision history for the SR 99 corridor from S. Spokane Street to Aloha Street over a 3-year period (2001–2003). Additional data were acquired in 2004 and the associated collision data analysis was presented in the *SR 99 Battery Street Tunnel Collision Evaluation* (Parsons Brinckerhoff 2006b).

Note that Section 409 of Title 23 of the United States Code prohibits use of the collision data presented and summarized in this report in any litigation against state, tribal, or local government that involves the location(s) mentioned in the collision data.

Several analyses were used to measure and assess collision characteristics:

- *Collision Rates*: To allow comparison of crash rates between corridor segments and to average rates on similar facilities, collisions per million vehicle-miles traveled (MVMT) were calculated for each corridor segment.
- *Collision Types*: To help identify possible factors associated with collisions, the project team reviewed the proportion of collisions by type for the major corridor segments. Collision rates specific to each crash type were also calculated. Collisions are grouped into the following categories:
 - Fixed-Object: Collisions with roadside barriers or objects (walls, guardrails, other roadside appurtenances).
 - Rear-End: Collisions where one or more vehicles strike slower-moving or stopped vehicles from behind.

- Sideswipe: Side-to-side collisions between two vehicles traveling in the same direction, often involving a lane change or straying from the travel lane.
- Other/Unknown: All other collision types, including enter-at-angle, pedestrian/bicycle, wrong direction of travel, overturned vehicles, and other unknown or unclassified collision types.
- *Collision Severity*: The share of injury collisions (per MVMT) relative to total collisions was reported.

As part of the *SR 99 Battery Street Tunnel Collision Evaluation*, collision reduction factors (CRFs) were calculated. CRFs, which estimate the collision reduction that could be expected for a given safety treatment, were estimated for the Battery Street Tunnel conditions based on the most applicable published CRFs from around the country. Additionally, CRFs were applied using broad ranges (high/low) in recognition of the level of uncertainty associated with application of these factors.

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Chapter 3 STUDIES AND COORDINATION

This section summarizes the studies and adopted plans undertaken in the region that are relevant to the Project. It also summarizes coordination activities undertaken to guide development of the Project's traffic and transportation components, and describes mechanisms for evaluating transportation system performance in support of the Project's SEPA Checklist. Chapters 6 and 7 provide additional information on coordinating with other projects and coordination during construction.

3.1 Relevant Studies and Plans

3.1.1 City of Seattle Comprehensive Plan (2005)

The City of Seattle's Comprehensive Plan, *Toward a Sustainable Seattle*, articulates a vision of how Seattle will grow in ways that sustain its citizens' values. The City first adopted the Comprehensive Plan in 1994 in response to the state Growth Management Act of 1990.

Multimodal transportation policies discussed in the Comprehensive Plan were used to define the Project's system elements. In particular, transportation demand policies and system management strategies were used to guide development of the Project's mitigation plans.

3.1.2 City of Seattle Transportation Strategic Plan (2005)

The *Transportation Strategic Plan* describes SDOT's vision, goals, and policies for achieving the City's long-range objectives. It describes the actions, projects, and programs that SDOT will take to promote economic growth in Seattle and the region, support livable neighborhoods, improve the environment, and address the traveling public's complex demands. Information from this plan was used to help refine the Project's travel demand models.

3.1.3 City of Seattle Bicycle Master Plan (2007)

The *Bicycle Master Plan* is a planning document that will be used to guide future improvements to Seattle's bicycle network. This master plan focuses on evaluating arterial streets to implement bike lanes and encourage more bicycling throughout the city of Seattle.

3.1.4 City of Seattle Center City Circulation Report (2003)

The City of Seattle conducted a study of transit and nonmotorized circulation and service options in the downtown area. This study is an effort to better integrate numerous independent transportation components and plans in the downtown area.

3.1.5 City of Seattle Center City Access Strategy (2007)

In preparation for construction and growth, including the AWVSRP, SDOT is planning, building, and monitoring the implementation of projects in the city center. This strategy involves creating a livable and walkable city center, integrating and simplifying the transit system, accommodating anticipated growth, maintaining access into downtown during major construction projects, and continuing mobility into the future.

3.1.6 City of Seattle Freight Mobility Strategic Action Plan (2005 Plan Update)

The *Freight Mobility Strategic Action Plan* presents a list of actions that SDOT will implement. These actions or tasks address administrative and functional actions that SDOT will carry out to benefit freight, in accordance with the Seattle Comprehensive Plan and the Seattle *Transportation Strategic Plan*. Actions include railroad grade separations, truck guide signing, street improvements, and ongoing communication with the Seattle freight community via the Seattle Freight Mobility Advisory Committee.

3.1.7 City of Seattle Transit Plan (2005)

The City of Seattle adopted a Transit Plan to define its transit strategies for its *Transportation Strategic Plan*. The Transit Plan's purpose is to provide sound direction on how Seattle can achieve the transit system it needs to meet long-term growth, economic, and transportation objectives for connecting downtown and the emerging set of urban villages. Information from the plan was used to help refine travel networks within the AWVSRP's travel demand models.

3.1.8 *Destination 2030* Metropolitan Transportation Plan (2001)

The *Destination 2030* Metropolitan Transportation Plan (MTP) is the adopted regional long-range transportation plan for the central Puget Sound region. The MTP comprises all transportation projects and programs planned for implementation by 2030 (funded and unfunded). The MTP also describes land use and socioeconomic conditions forecasted for 2030, which form the basis for PSRC's travel demand models (the Project's travel demand model, as described in Chapter 2, is an enhanced version of the PSRC model).

The MTP describes the regional transportation system's performance, given implementation of the full complement of projects identified in the plan. It illustrates the cumulative effects of implementing all of the transportation projects and programs planned throughout the region. Conversely, the analysis conducted for the Project presumes only those projects that have secured funding and are presently programmed for implementation by 2030.

3.1.9 Sound Transit *Sound Move* Vision Plan (1996)

In 1996, voters approved funding for Sound Transit to provide a regional system of transit improvements. This includes Sounder commuter rail, ST Express regional bus service, numerous capital improvements (including park-and-ride lots, transit centers, and direct access ramps), and Link light rail. The plan that details this 10-year mix of projects and services is known as *Sound Move*.

The *Sound Move* plan provides input on transit service assumptions for Link light rail, Sounder commuter rail, and ST Express bus service to operate in the greater downtown Seattle area. The transit investments approved in the *Sound Move* plan are included as part of the baseline definition for the Project's Build Alternative and the 2030 Baseline Scenario.

3.1.10 King County Transit Now (2006)

The Transit Now initiative to expand Metro bus transit service by 15 to 20 percent over the next 10 years was approved by King County voters in the general election on November 7, 2006 (King County Ordinance 2006-0285). Elements of Transit Now are expected to supplement the strategies identified through the Project's construction transportation planning process.

3.1.11 King County Metro Six-Year Transit Development Plan (2004)

The King County Metro *Six-Year Transit Development Plan for 2002 to 2007* provides the framework for transit service and capital investments. This plan guides transit development for 2002 through 2007.

The 6-year transit plan was used to calculate projected annual transit service growth for the regional travel demand models, including Metro bus service and TDM strategies supplied by King County Metro.

3.1.12 King County Metro Transit Tunnel Conversion Project Performance Reports (2005–2007)

King County Metro, under the "Agreement Regarding the Design, Construction and Operation of the Downtown Seattle Transit Tunnel and Related Facilities," was mandated to provide periodic reports on the downtown transportation system's performance during the closure of the Downtown Transit Tunnel Conversion project. These reports provided updates on a number of performance measures during the tunnel's closure.

3.1.13 Alaskan Way Viaduct Project: Task 1 Report (December 1996)

The Task 1 Report provides insights on travel characteristics of trips made on the Alaskan Way Viaduct. The report led to four distinct approaches (Framework Policies) for seeking a course of action. Information from this

report provided comparison information used in developing travel forecasts and traffic analysis activities.

3.1.14 Washington State Transportation Plan 2007–2026 (November 2006)

The *Washington State Transportation Plan 2007–2026* identifies the state transportation system's needs and deficiencies and includes designated state highways. The plan was the result of a continuous, comprehensive, and coordinated planning and outreach effort with other agencies and the public to identify potential transportation improvements.

3.2 Coordination

3.2.1 Enhancements and Mitigation Advisory Team

The Enhancements and Mitigation Advisory Team (EMAT) is a three-agency committee (WSDOT, King County, and SDOT) formed in September 2007 to oversee the development and selection of the SR 99/Initial Transit Enhancements and Other Improvements.

3.2.2 Other Coordination

Ongoing coordination was conducted with agencies that manage operations or have a stake in particular transportation modes. This included coordination with:

- City of Seattle planning, design, and operations staff for multimodal design and operations input.
- King County Metro staff for transit service and transit capital planning.

Chapter 4 AFFECTED ENVIRONMENT

This chapter describes existing conditions (the 2005 analysis year) for transportation systems within the study area. It also includes information on current transportation facilities, their use, and their performance. This information helps establish an understanding of current conditions and serves as a basis against which projected future conditions for the Year of Opening (2011), the 2030 Baseline, and the 2030 Build Alternative can be assessed.

4.1 Study Area and Regional Context

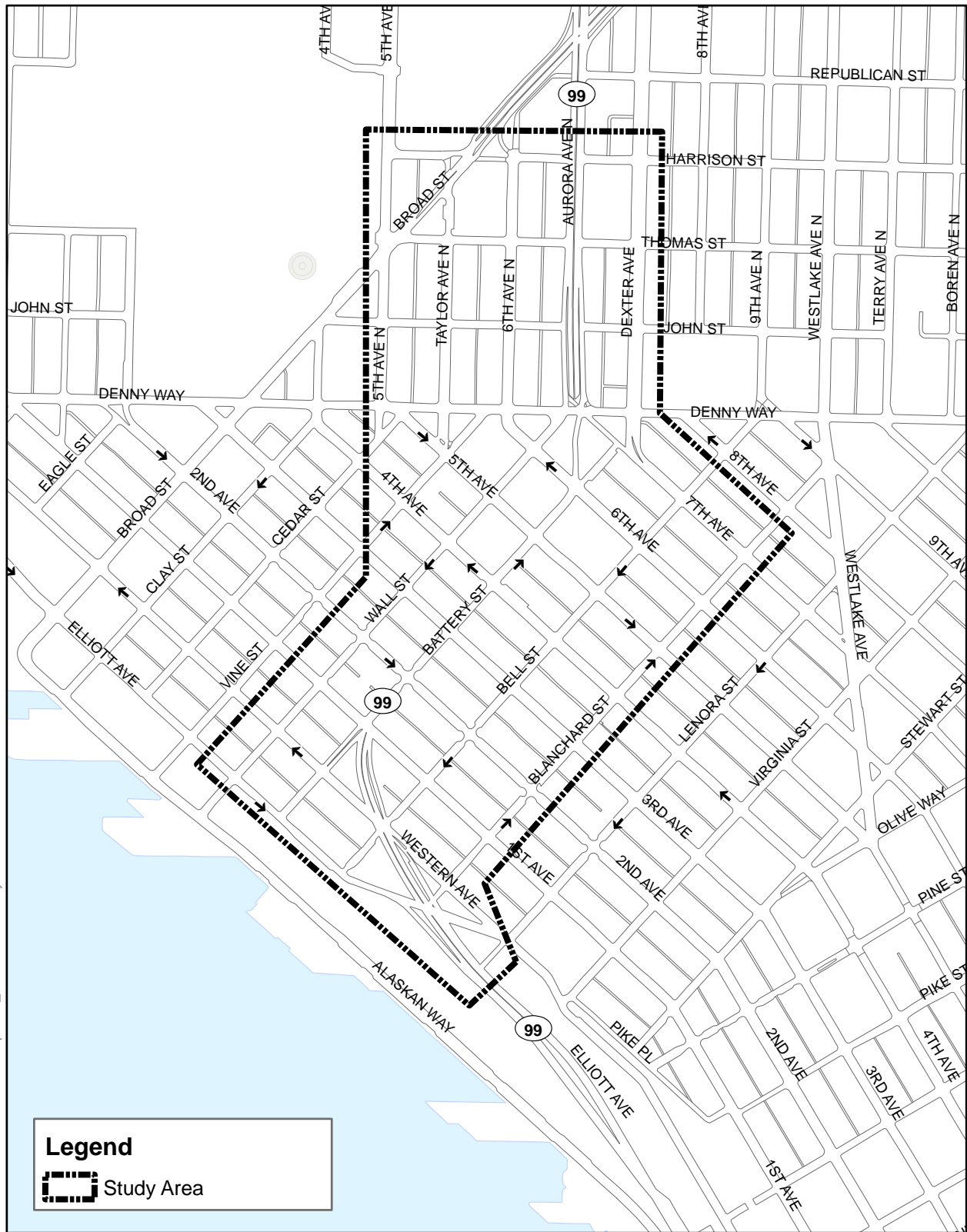
The Project would make safety improvements to the SR 99 facility in the project area. The project limits extend from the sign bridge to be replaced on SR 99 at approximately Virginia Street to the proposed sign bridge on SR 99 at about Ward Street. The majority of the improvements would involve the Battery Street Tunnel itself.

The transportation study area, shown in Exhibit 4-1, encompasses the Project's major construction limits on SR 99 and nearby transportation facilities that are closely related to or affected by the SR 99 corridor. This area is roughly bordered by Elliott Avenue, Blanchard Street, Seventh Avenue, Dexter Avenue, Harrison Street, Fifth Avenue N., and Vine Street. It includes a range of multimodal transportation facilities and service types, including a limited-access highway, arterial streets, transit services and facilities, nonmotorized facilities and routes, and an important freight corridor.

The transportation study area establishes the area for which the Project's transportation performance and effects are assessed. Any information provided that is beyond the study area boundary is meant to give context for the data being presented. During construction closures of the Battery Street Tunnel, some downtown and Belltown streets outside of the study area would be affected by detouring traffic. The detours and conditions during construction are discussed qualitatively in Chapter 6.

In addition to the Project's major construction, there would be improvements related to the sign structures located on SR 99. The existing sign bridges on SR 99 at approximately Virginia Street and at Thomas Street would be demolished and reconstructed. An additional new sign would be installed on SR 99 at approximately Ward Street. Some of the sign structure construction would occur outside of the transportation study area and is addressed qualitatively in Chapter 6.

FILE: \\stfiv\aduct\GIS\le-3\Maps\EA_BST\Ex 4-1 study area.mxd



0 1,000 2,000 Feet

Basemap Data Source: King County, 2005.

Exhibit 4-1 Study Area

4.2 Transportation Facilities and Services

This section provides an overview of the transportation system components within the study area. This includes highways, arterial roadways, transit services and facilities, pedestrian and bicycle facilities, railroads, and freight corridors.

4.2.1 SR 99

SR 99 serves important local and regional transportation functions. SR 99 is an important alternative route to Interstate 5 (I-5), the most heavily used highway in the Pacific Northwest. It also provides an important link to major league sports stadiums in the north and south ends of downtown, and access to I-90 for trips coming from northwest Seattle.

The Battery Street Tunnel, built in the 1950s, is approximately one-half mile in length and carries two lanes of SR 99 in each direction. A center wall separates northbound and southbound lanes, resulting in cross sections that have two 12.5-foot-wide lanes with raised curbs and walkways immediately adjacent to the travel lanes (25-foot curb-to-curb distance). The inside raised walkway is 1.5 feet wide, and the outside raised walkway is 3 feet wide. Tunnel walls are adjacent to the walkways. The Battery Street Tunnel ramps connect to SR 99 at the south tunnel portal.

North of the north portal, ramps and side street connections to SR 99 provide access to the South Lake Union area. Traffic movements associated with these connections occur well outside of the tunnel, though congestion associated with them can affect traffic flow in the Battery Street Tunnel.

4.2.2 Arterial and Local Streets

Nearly all downtown area streets are designated as either principal or minor arterials. Principal arterials provide major north–south travelways, with a mixture of minor and collector arterials that provide travel opportunities in the east and west directions.

Although SR 99 is designated as an Urban Expressway, approximately 62 percent of all users (vehicle and transit) on the viaduct have one trip-end in the greater downtown Seattle area on a daily basis. Therefore, connections to the downtown street network are of considerable importance. Section 4.4.2 provides additional information on connections to the surrounding study area and roadway facilities.

4.2.3 Transit Services

All bus transit serving north Seattle by way of SR 99 enters or exits downtown at the Denny Way ramps. From there, a number of surface streets provide

access into the downtown area. Transit services do not use the Battery Street Tunnel.

An additional transit service in the study area is the Seattle Monorail, which runs along Fifth Avenue, connecting the Seattle Center and Westlake Center.

As listed in Exhibit 4-2 and shown in Exhibit 4-3, several King County Metro routes use SR 99 north of the Battery Street Tunnel north portal. These transit routes use the southbound off-ramp at Denny Way and access northbound SR 99 either from the northbound on-ramp at Denny Way or from John Street via Dexter Avenue N.

Exhibit 4-2. Existing Transit Routes Using SR 99

Route No.	Description	Ramp Usage	Buses Per Hour	
			AM Peak	PM Peak
5	To Seattle	Denny Way	5	4
	To Shoreline	John Street	5	4
5E	To Seattle	Denny Way	3	
	To Shoreline	John Street		3
26E	To Seattle	Denny Way	3	
	To Green Lake	Denny Way		3
28E	To Seattle	Denny Way	3	
	To Broadview	Denny Way		3
358	To Seattle	Denny Way	9	4
	To Aurora Village	John Street	4	8
		TOTAL	32	29

Note: "E" indicates Express route.

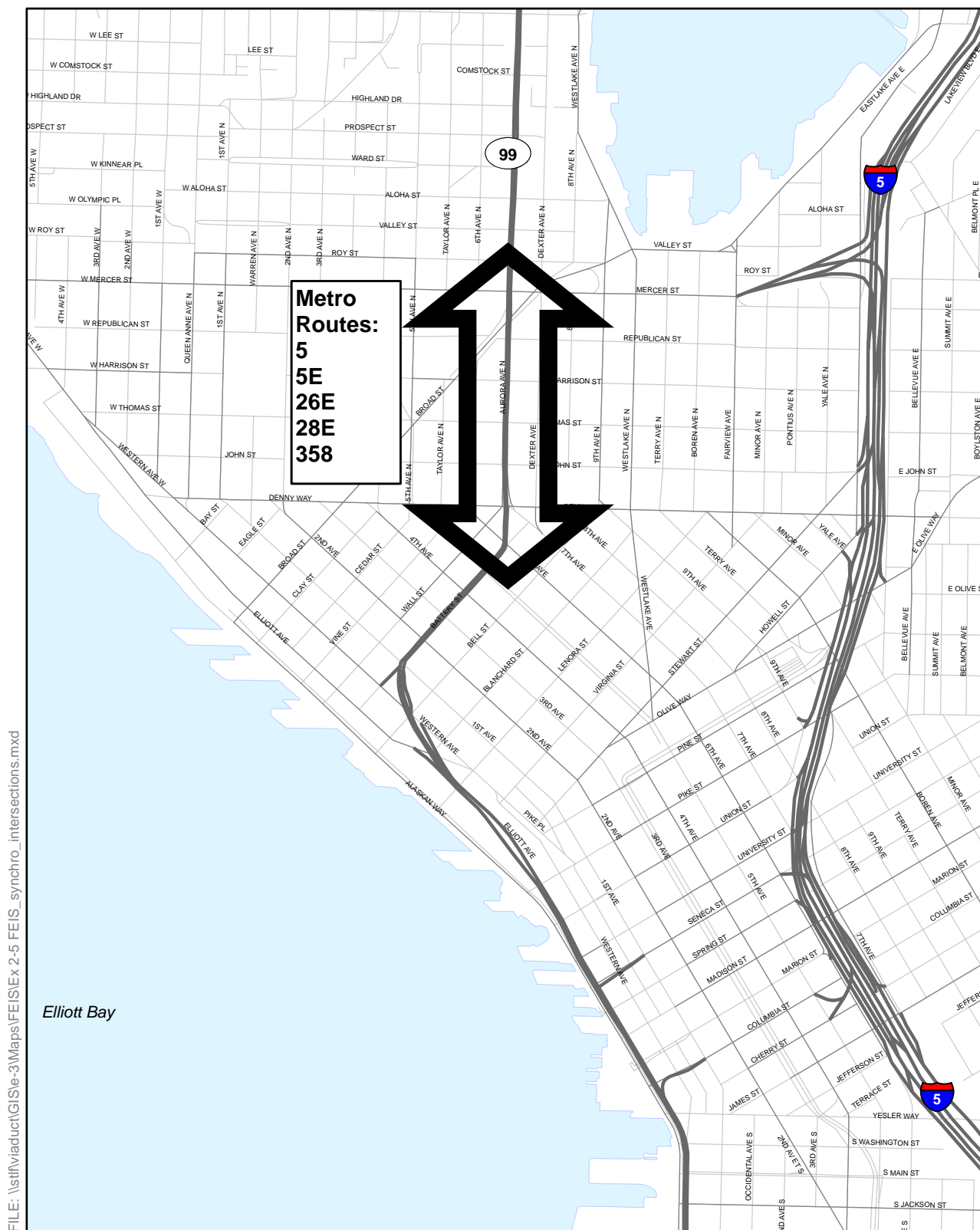
4.2.4 Pedestrian and Bicycle Facilities

Pedestrians

Sidewalks are found on streets in the study area. There are no sidewalks through the Battery Street Tunnel. Pedestrian facilities are discussed further in the *Accessibility* section of *Existing Transportation Conditions* (Section 4.3.2).

Bicycles

Major bicycle routes in the study area include Second Avenue and Dexter Avenue N., both of which feature bicycle lanes. Roadway facilities in the study area commonly used by bicyclists are listed in Exhibit 4-4.



Source: King County, 2007.

Exhibit 4-4. Streets Commonly Used by Bicyclists

Arterial	From	To
First Avenue	Denny Way	Blanchard Street
Second Avenue	Denny Way	Yesler Way
Fourth Avenue	Yesler Way	Bell Street
Seventh Avenue	Battery Street	Blanchard Street
Bell Street	Seventh Avenue	First Avenue
Blanchard Street	Western Avenue	Seventh Avenue
Dexter Avenue N.	Denny Way	Fremont Bridge/Nickerson
Dexter Avenue	Denny Way	Battery Street
Western Avenue	Blanchard Street	Yesler Way

Bicycle facilities are shown in Exhibit 4-5. The bicycle lane on Dexter Avenue N. connects to the Fremont Bridge and the Burke-Gilman Trail, which provides regional connections to Ballard, the University District, and points beyond along Lake Washington.

Existing bicycle counts were previously collected during the PM peak hour. In the Belltown area along Elliott Avenue at Vine Street, approximately five bicyclists per hour were observed.

4.2.5 Parking

Public parking is defined as: (1) parking spaces regulated by the City, and (2) pay parking lots where private entities collect money but parking spaces are available to the public. There are three categories of parking:

On-Street Short-Term Parking

Existing short-term parking includes spaces with time restrictions; metered spaces (including pay stations); and taxi, bus, and police parking.

On-Street Long-Term Parking

On-street long-term parking includes unmetered, unrestricted, on-street public parking.

Off-Street Parking

Off-street parking includes privately owned parking lots where the public can park for a fee. In most cases, public parking does not include private business customer or employee parking.

Parking in the Project Study Area

Parking in the study area mainly consists of off-street parking (public pay lots) and on-street parking restricted to 2-hour limits by meters/pay stations. City parking meters and pay stations are generally in effect from 8:00 am to 6:00 pm, Monday through Saturday (parking at all City meters and pay stations is free on Sunday).

On-street parking on Battery Street consists of 2-hour metered parallel parking along both sides of the street from First Avenue to Sixth Avenue. Some back-in angle parking is also available along the north side of Battery Street between First and Second Avenues. Parking is not allowed between Sixth Avenue and the Denny Way on-ramp to northbound SR 99.

The following exceptions to the 2-hour metered parking in Belltown occur along Western Avenue, Elliott Avenue, and Broad Street:

- There are several load zones on the east side of Western Avenue along the two blocks between Wall Street and Cedar Street.
- On the west side of Western Avenue between Broad Street and Denny Way there is unrestricted (unmetered) parking.
- There are bus and load zones for approximately two blocks on the west side of Elliott Avenue between Vine and Clay Streets.
- No parking is allowed on Broad Street between First Avenue and Elliott Avenue.

4.2.6 Freight

The state of Washington classifies freight routes according to the number of tons of cargo carried per year. Truck freight tonnage on interstates, state routes, and city streets near the study area is shown in Exhibit 4-6.

The City of Seattle designates all arterials as truck routes and has also classified certain streets as Major Truck Streets. By policy, the City will “monitor these streets and make operating, design, access and/or service changes, as well as capital investments, to accommodate trucks and to preserve and improve commercial transportation mobility and access on these major truck streets.” Seattle’s Major Truck Streets within the study area are shown in Exhibit 4-7. SR 99 is designated as a Major Truck Street, as are all or portions of Broad Street, Western Avenue, and Elliott Avenue.

SR 99 is identified as a Seaport Highway Connector route. SDOT and the Port of Seattle have identified key existing ground transportation routes that provide connections to Port facilities. The Seaport Highway Connectors are existing routes that provide safe, reliable, efficient, and direct access between a Port marine facility and the state highway or interstate system.

Exhibit 4-6. Freight Tonnage Designations

Route Name	Segment	Classification
I-5	Oregon border to Canadian border	T-1
I-5	Express Lanes	T-1
SR 99	Elliott Avenue to Green Lake Way (includes Battery Street Tunnel)	T-2
SR 99	E. Marginal Way to Elliott Avenue (includes Alaskan Way Viaduct)	T-1
15 th Avenue NW	W. Emerson Street to NW 50 th Street (includes the Ballard Bridge)	T-2
15 th Avenue W.	W. Galer Street to W. Emerson Street	T-2
Elliott Avenue W.	W. Denny Way to W. Galer Street	T-1
Fourth Avenue	Yesler Way to Denny Way	T-2
Alaskan Way	Columbia Street to Broad Street	T-2

Source: WSDOT 2007a.

Classification:

T-1: more than 10 million tons per year

T-2: 4 million to 10 million tons per year

Weight Restrictions

Following the Nisqually earthquake of February 2001, weight restrictions were established on the Alaskan Way Viaduct that require both bus and truck traffic to use the right lane only. In addition, vehicles weighing more than 105,000 pounds are prohibited. Travel speed for trucks is reduced from 50 miles per hour (mph) to 40 mph. These restrictions also limit the use of the southbound exit to First Avenue S., which is located on the left side of the roadway. Further deterioration of the viaduct structure could lead to additional restrictions.

Hazardous Materials and Explosives Restrictions

Transport of hazardous materials is prohibited in the Battery Street Tunnel and depressed roadway from the Alaskan Way Viaduct to Aurora Avenue at all times. Hazardous materials are not allowed on the Alaskan Way Viaduct between 7:00 a.m. and 9:00 a.m. and 4:00 p.m. and 6:00 p.m. on weekdays.

In addition, explosives are prohibited from being transported on the Alaskan Way Viaduct and in the Battery Street Tunnel and depressed roadway from the Alaskan Way Viaduct to Aurora Avenue at all times.

Alternative Truck Routes

In case of congestion, incidents, or lack of access to the Alaskan Way Viaduct, different types of trucks have different alternative route options. All vehicles would have the option to use Alaskan Way and Broad Street or I-5 instead of the viaduct and Battery Street Tunnel.

Trucks up to 30 feet long have the option to divert to city streets to get through the downtown area. Vehicles over 30 feet long face certain conditions associated with the use of streets within the area known as the Downtown Traffic Control Zone (shown in Exhibit 4-7). The following conditions are associated with the Downtown Traffic Control Zone:

- Vehicles over 30 feet in length are restricted Monday through Saturday between the hours of 6:00 a.m. and 7:00 p.m. Special permission is required to travel within the zone during those hours.
- Over-legal loads are not permitted in the Downtown Traffic Control Zone between the hours of 6:00 a.m. and 7:00 p.m., Monday through Friday. Special permits must be obtained for any movement in this area. State permitted over-legal loads and vehicles must also obtain a special one-day permit for movement in the Downtown Traffic Control Zone.

SDOT does not designate over-legal routes. Appropriate routes are selected via the permit approval process. Alaskan Way and Broad Street have a history of permitted over-legal truck trip use, and these routes would likely continue to be permitted routes.

I-5 presents challenges to truckers passing through downtown Seattle. Heavy congestion persists for much of the day. Frequent on- and off-ramps and heavy volumes of traffic entering and exiting the freeway make truck travel particularly difficult and require trucks to change lanes frequently as they travel through downtown. The Port of Seattle has identified access to and from the north on I-5 and poor operations on I-5 through downtown Seattle as important and problematic freight concerns.

4.3 Existing Transportation Conditions

This section describes existing transportation conditions in terms of current estimated travel demands and performance measures associated with mobility, accessibility, and safety.

4.3.1 Mobility

Mobility can be thought of as the ability for people and goods to move between locations. This section describes measures relating to mobility, including travel demand and traffic patterns, and traffic and operating conditions.

Travel Demand and Traffic Patterns

Alaskan Way Viaduct (SR 99) Users

SR 99 travels north-south, passing through downtown Seattle on the Alaskan Way Viaduct. The following sections present data that describes current SR 99 users within the study area.

Existing SR 99 Daily Traffic Patterns

Exhibits 4-8 and 4-9 show daily traffic patterns on the SR 99 corridor in the southbound and northbound directions, respectively. Arrows indicate locations where traffic enters or exits the corridor. Because access in the South Lake Union area is provided by many closely spaced cross-streets, these movements are shown grouped.

Along Aurora Avenue, almost half of trips using SR 99 enter and exit the corridor north of the Battery Street Tunnel. Of the 40,500 southbound daily vehicle trips on Aurora Avenue, 8,500 trips exit in the South Lake Union area, while 11,300 trips exit at Denny Way. Northbound, of the 39,000 daily trips on Aurora Avenue, 11,000 trips entered from the Denny Way on-ramp and an additional 7,500 trips entered from side-street connections in the South Lake Union area.

Some 31,000 southbound and 32,400 northbound vehicles use the Battery Street Tunnel on a typical weekday, totaling 63,400 trips through the Battery Street Tunnel. They include the remainder of the Aurora Avenue trips (20,700 southbound trips, 20,500 northbound trips), as well as 10,300 additional southbound trips joining the corridor in the South Lake Union area, and 11,500 northbound trips destined to exit in the South Lake Union area.

A relatively small number of trips enter or exit at the Battery Street Tunnel ramps in the Belltown area. About 2,800 vehicles exit southbound and 3,800 vehicles enter northbound at this location at the south portal of the Battery Street Tunnel.

The Elliott Avenue on-ramp and Western Avenue off-ramp are major access points to the corridor. About 17,100 vehicles enter SR 99 southbound on the Elliott Avenue on-ramp, while 17,400 vehicles exit on the Western Avenue off-ramp. These connections provide access to Belltown, Lower Queen Anne, and points farther north, including the Ballard/Interbay areas via 15th Avenue W.

2005 Existing Mainline and Ramp Volumes – AM Peak Hour

Traffic volumes on the SR 99 corridor are highest during commuting hours. In the morning, peak-hour traffic volumes on SR 99 are fairly directional,

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Exhibit 4-8
Southbound SR 99
Daily Travel Patterns

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Exhibit 4-9
Northbound SR 99
Daily Travel Patterns

as shown in Exhibit 4-10. AM peak hour mainline volumes are higher in the southbound direction, as more vehicles are entering the downtown area (4,120 vehicles) than are leaving it (2,610 vehicles). Southbound off-ramp volumes at Denny Way (1,230 vehicles) exceed those on the northbound on-ramp (430 vehicles). In the Battery Street Tunnel, the volumes are fairly balanced, with the volume of northbound vehicles (2,850 vehicles) slightly exceeding the volume of southbound vehicles (2,640 vehicles). The ramps providing access to and from the north show directionality, with 410 vehicles exiting southbound on the Battery Street Tunnel off-ramp and only 150 vehicles entering northbound on the Battery Street Tunnel on-ramp. The ramps to and from the south at Elliott and Western Avenues show directionality as well, with 1,130 vehicles entering southbound and 1,330 vehicles exiting northbound.

2005 Existing Mainline and Ramp Volumes – PM Peak Hour

Similar to the AM peak, PM peak-hour traffic volumes along SR 99 are directional, with heavier volumes leaving the central downtown (4,300 vehicles) than are entering it (3,345 vehicles). As shown in Exhibit 4-10, northbound on-ramp volumes at Denny Way (1,340 vehicles) exceed those on the southbound off-ramp (680 vehicles). In the Battery Street Tunnel, the volume of northbound vehicles (3,260 vehicles) again exceeds the volume of southbound vehicles (2,790 vehicles). The Battery Street Tunnel ramps providing access to and from the north also show directionality, with 490 vehicles entering northbound but only 200 vehicles exiting southbound. The ramps to and from the south show directionality as well, with 1,320 vehicles entering southbound and 1,200 vehicles exiting northbound.

Pedestrians and Bicycles

The study area includes two major pedestrian facilities providing connections to the waterfront: the Bell Street Pedestrian Bridge, which extends over Alaskan Way and the BNSF railroad tracks and connects to the Bell Street Pier, and the Lenora Street Pedestrian Bridge, which provides access from Elliott Avenue to the east side of Alaskan Way.

Elliott Avenue and Western Avenue serve as the major north-south routes through the Belltown neighborhood for pedestrians. These two streets converge at the north end of the Pike Place Market. Pedestrian crossings at the beginning of the southbound on-ramp at Elliott Avenue and at the end of the northbound off-ramp at Western Avenue often result in delays for vehicles using those ramps.

Exhibit 4-11 provides existing pedestrian counts for various intersections within the study area during the PM peak hour. The data collected in Exhibit 4-11 were collected in winter and during the PM peak hour; pedestrian activity near the waterfront is substantially higher in summer and on weekends. Updated pedestrian volumes for weekdays and weekends were collected by video near the waterfront in August 2006 and are provided in Exhibits 4-12 and 4-13.

Exhibit 4-11. Existing PM Peak Hour Pedestrian Counts

Street	Cross-Street	North Leg	South Leg	East Leg	West Leg	Control
Alaskan Way	Wall Street	40	40	40	115	Signalized
Alaskan Way	Bell Street	25		35	165	Unsignalized
Alaskan Way	Bell Street Pedestrian Bridge	145		*	*	Grade-separated
Elliott Avenue	Battery Street	25	15	35	360	Unsignalized
Elliott Avenue	Blanchard	10	5	50	125	Unsignalized
Thomas Street	Sixth Avenue	10	15	20	20	Unsignalized
Fifth Avenue	Broad Street	16	23	22	34	Signalized
Dexter Avenue	Denny Way	47	40	54	14	Signalized
Dexter Avenue	Thomas Street	2	0	22	12	Unsignalized
Denny Way	NB SR 99	42	25	24	0	Signalized
Denny Way	SB SR 99	40	18	0	23	Signalized

NB = northbound; SB = Southbound

* No such leg

Exhibit 4-12. Existing (August 2006) Weekday PM Peak Hour Pedestrian Counts

Street	Cross-Street	North Leg	South Leg	East Leg	West Leg	Control
Alaskan Way	Bell Street	**	**	**	305	Signalized
Alaskan Way	Bell Street Pedestrian Bridge	199		*	*	Grade-separated

* No such leg

** Leg not counted

Exhibit 4-13. Existing (August 2006) Weekend PM Peak Hour Pedestrian Counts

Street	Cross-Street	North Leg	South Leg	East Leg	West Leg	Control
Alaskan Way	Bell Street	**	**	**	1,582	Signalized
Alaskan Way	Bell Street Pedestrian Bridge	422		*	*	Grade-separated

* No such leg

** Leg not counted

The large number of visitors to the waterfront is augmented by activity related to the cruise ship industry. During the 2008 cruise season, the Bell Street Cruise Terminal at Pier 66 (Bell Street) is projected to accommodate 79 cruise ship visits and approximately 250,000 passengers and crew. Cruise ships come in and out of port on all days of the week with the highest frequency on Fridays, Saturdays, and Sundays. Bell Street Pier also includes the Bell Harbor International Conference Center, which hosts various conferences and other activities.

Near the north portal of the Battery Street Tunnel, Denny Way and Dexter Avenue serve as the primary east-west and north-south pedestrian routes, respectively. Pedestrian activity increases near the Seattle Center during events to levels considerably higher than during non-event times.

Freight and Commercial Traffic

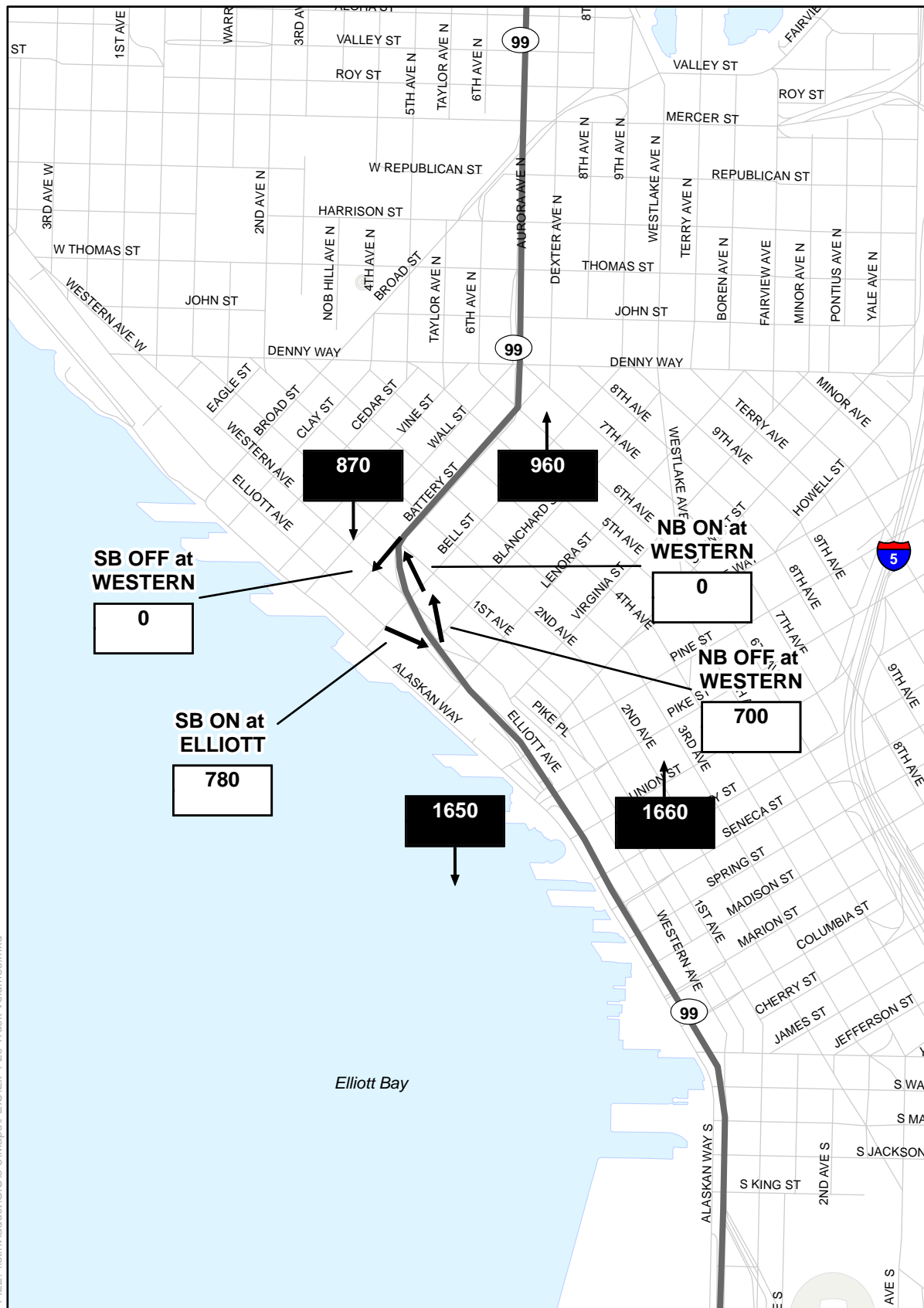
Truck volume and classification counts were collected by video along the SR 99 corridor in downtown Seattle in June 2006. As shown in Exhibit 4-14, an estimated 1,830 trucks use SR 99 through the Battery Street Tunnel on a typical weekday. This includes single-unit trucks (not articulated), combination trucks (an articulated truck pulling one or two trailers), and tanker (liquid transport) trucks. Garbage trucks and concrete trucks were classified as single-unit trucks. The truck data exclude pick-up trucks and vans, some of which serve commercial vehicle trip functions.

Travel Patterns

The Elliott/Western ramps provide access to the Ballard/Interbay industrial areas (by way of 15th Avenue N.W.), as well as other areas northwest of downtown. A large share of truck traffic uses the Elliott/Western ramps, though a majority of trucks continue north on SR 99 through the Battery Street Tunnel. A smaller share of traffic accesses downtown directly using the Seneca Street and Columbia Street ramps.

Northbound, 11 percent of trucks (210 trucks) exit SR 99 at Seneca Street daily, 37 percent (700 trucks) exit to Western Avenue, and 51 percent (960 trucks) continue through the Battery Street Tunnel. Southbound, 47 percent of trucks (870 trucks) access the viaduct through the Battery Street Tunnel, 42 percent (780 trucks) by way of the Elliott Street on-ramp, and 11 percent (200 trucks) using the Columbia Street on-ramp daily. When truck volumes were recorded in 2006, no trucks were observed using the Battery Street Tunnel ramps.

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Feet



Ramp Volumes (2006)

SR 99 Mainline Volumes (2006)

**Exhibit 4-14: Daily
Truck Volumes**

Classification of Truck Types

The composition of trucks on the viaduct along the central waterfront is approximately 88 percent single-unit trucks, 9 percent combination trucks, and 3 percent tanker trucks (single and combination units). A higher share of combination and tanker trucks use the Elliott/Western corridors, hence the composition in the Battery Street Tunnel is 93 percent single units, 6 percent combination trucks, and 1 percent tankers.

Tanker/Liquid Transport Trucks

Between 80 and 100 tanker trucks are estimated to use the SR 99 corridor each day (40 to 50 per direction). Tanker trucks may carry hazardous loads, such as fuel or chemicals. Harbor Island is home to several fuel tank farms that serve as a distribution center for the city and regional energy markets. However, not all tanker trucks carry hazardous cargoes. For instance, they could be carrying milk or even water to provide dust control on construction sites. Transport of hazardous materials is prohibited in the Battery Street Tunnel at all times.

The data collected did not inventory hazardous materials trips, so the share of these trucks that haul hazardous (including combustible or flammable) materials is unknown. Approximately 15 percent of tanker trucks use the viaduct during times when hazardous cargoes are prohibited anywhere on the viaduct (between 7:00 and 9:00 a.m. and 4:00 and 6:00 p.m.), so are likely to be carrying non-hazardous loads. Up to 70 percent of the observed tanker truck volumes (55 to 70 tankers per day) could therefore be legally carrying flammable or hazardous loads on the viaduct.

Hourly Truck Volumes

Unlike overall traffic volumes that peak during the morning and evening commutes during weekdays, truck volumes peak on weekdays during midday and afternoon. Exhibit 4-15 shows hourly truck volumes on SR 99 between the First Avenue S. ramps and Columbia/Seneca Street ramps, which is the busiest segment of the viaduct. Although the segment of SR 99 referenced in Exhibit 4-15 is south of the Battery Street Tunnel, the overall trends can be more broadly applied to SR 99. Northbound truck volumes are quite steady between about 6:00 a.m. and 8:00 p.m., peaking between 2:00 p.m. and 3:00 p.m. Southbound truck traffic peaks more sharply (higher volumes, but for fewer hours). Southbound truck volumes are equal to or greater than northbound truck volumes from about 9:00 a.m. to 6:00 p.m. However, peak volumes generally occur between 11:00 a.m. and 5:00 p.m. with the highest peak in volumes between 3:00 p.m. and 4:00 p.m. Use of the viaduct by trucks between about 8:00 p.m. and 5:00 a.m. is low.

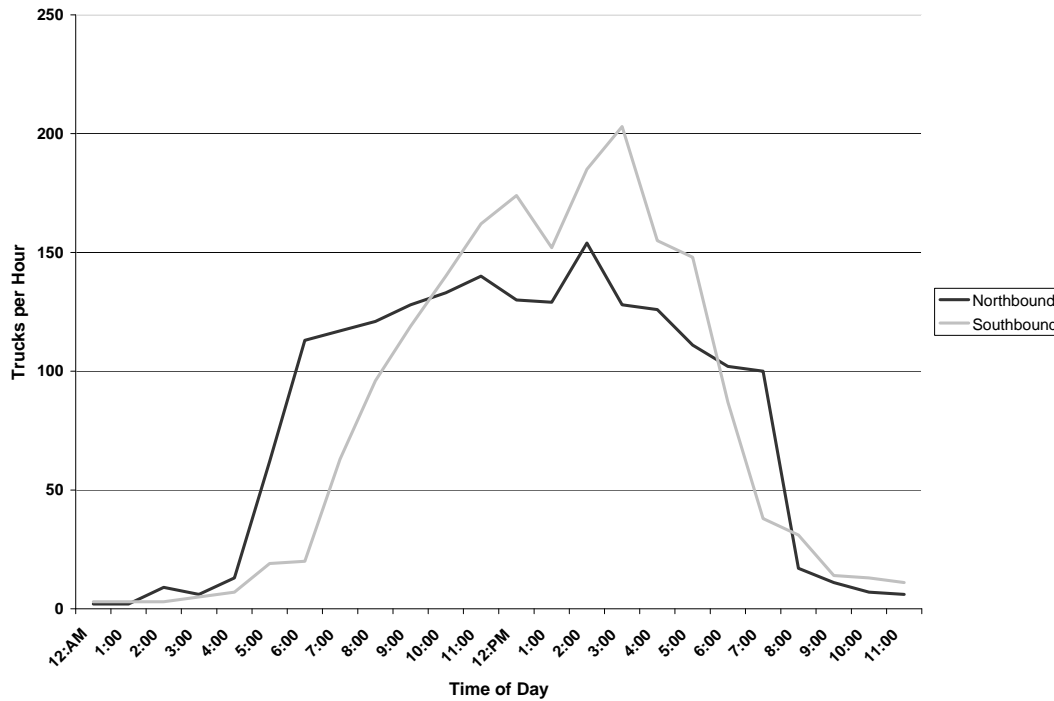


Exhibit 4-15. Hourly Truck Volumes on the Alaskan Way Viaduct

Note: Includes single-unit trucks (not articulated), combination trucks (an articulated truck pulling one or two trailers), and tanker (liquid transport) trucks. The truck data exclude pick-up trucks and vans, some of which serve commercial vehicle trip functions.

Traffic Operations

Traffic operations were analyzed for SR 99 and the arterial street system adjacent and proximate to the corridor.

SR 99 Mainline Traffic Operations

Mainline traffic performance was modeled using VISSIM simulation software. The level of service (LOS) for mainline and ramp operations is calculated based on speed and density, as projected in VISSIM. These results are presented in Exhibits 4-16 and 4-17.

The existing 2005 AM and PM peak segment speed results are shown in Exhibits 4-18 and 4-19. These speeds may be compared with posted speed limits to gauge the level of delay experienced on the mainline during the AM and PM peak hours. The posted speed on the northbound mainline is 50 mph between the south end of the project area and the Western Avenue off-ramp. North of the Western Avenue off-ramp and through the Battery Street Tunnel, the posted speed drops to 40 mph. The posted speed remains at 40 mph to the north end of the project limits. The southbound posted speed limit is 40 mph from the north end of the project area, through the Battery Street

Tunnel, to the Elliott Avenue on-ramp, where it increases to 50 mph. There is a posted advisory speed limit of 35 mph through the Battery Street Tunnel.

Exhibit 4-16. Existing (2005) AM Peak Hour SR 99 Segment LOS

Southbound			Northbound
North of Broad Street	E	C	North of Broad Street
Broad Street to Battery Street Tunnel	E	C	Battery Street Tunnel to Broad Street
Battery Street Tunnel	E	E	Battery Street Tunnel
Battery Street Tunnel to Elliott On-ramp	D	F	Western Off-ramp to Battery Street Tunnel
South of Elliott On-ramp	C	D	South of Western Off-ramp

Exhibit 4-17. Existing (2005) PM Peak Hour SR 99 Segment LOS

Southbound			Northbound
North of Broad Street	D	E	North of Broad Street
Broad Street to Battery Street Tunnel	D	E	Battery Street Tunnel to Broad Street
Battery Street Tunnel	D	F	Battery Street Tunnel
Battery Street Tunnel to Elliott On-ramp	E	F	Western Off-ramp to Battery Street Tunnel
South of Elliott On-ramp	D	D	South of Western Off-ramp

**Exhibit 4-18. Modeled Existing (2005) AM Peak Hour SR 99 Segment Speeds
(miles per hour)**

Southbound			Northbound
North of Broad Street	40	41	North of Broad Street
Broad Street to Battery Street Tunnel	36	40	Battery Street Tunnel to Broad Street
Battery Street Tunnel	37	34	Battery Street Tunnel
Battery Street Tunnel to Elliott On-ramp	37	26	Western Off-ramp to Battery Street Tunnel
South of Elliott On-ramp	48	44	South of Western Off-ramp

**Exhibit 4-19. Modeled Existing (2005) PM Peak Hour SR 99 Segment Speeds
(miles per hour)**

Southbound			Northbound
North of Broad Street	41	36	North of Broad Street
Broad Street to Battery Street Tunnel	42	38	Battery Street Tunnel to Broad Street
Battery Street Tunnel	42	36	Battery Street Tunnel
Battery Street Tunnel to Elliott On-ramp	35	26	Western Off-ramp to Battery Street Tunnel
South of Elliott On-ramp	48	50	South of Western Off-ramp

Arterial Traffic Operations

Traffic operations at signalized intersections in the study area were assessed to determine intersection LOS and average vehicle delay. All intersections under the existing condition are expected to operate at LOS D or better during

both the AM and PM peak hours. Exhibit 4-20 presents traffic operations for the intersections within the study area.

Exhibit 4-20. Existing (2005) AM and PM Peak-Hour Detailed Traffic Operations

Street	Cross Street	AM Peak Hour		PM Peak Hour	
		Avg. Vehicle Delay (sec)	LOS	Avg. Vehicle Delay (sec)	LOS
Western Avenue	Battery Street	17.7	B	14.9	B
Western Avenue	Wall Street	21.1	C	29.5	C
First Avenue	Wall Street	18.7	B	22.2	C
Second Avenue	Wall Street	11.9	B	14.9	B
Third Avenue	Wall Street	10.5	B	19.3	B
Fourth Avenue	Wall Street	22.5	C	4.3	A
Fourth Avenue	Battery Street	21.3	B	20.1	C
Fourth Avenue	Bell Street	4.2	A	10.0	B
Fourth Avenue	Blanchard Street	9.2	A	14.5	B
Fifth Avenue	Wall Street	16.6	A	11.4	B
Fifth Avenue	Battery Street	17.9	B	21.0	C
Fifth Avenue	Bell Street	11.3	B	15.7	B
Fifth Avenue	Blanchard Street	6.1	A	11.4	B
Fifth Avenue	Denny Way	24.4	C	17.8	B
Fifth Avenue	Broad Street	49.7	D	34.2	C
Sixth Avenue	Wall Street	9.7	A	5.7	A
Sixth Avenue	Battery Street	15.9	B	25.8	C
Sixth Avenue	Bell Street	16.5	B	14.6	B
Sixth Avenue	Blanchard Street	7.7	A	19.6	B
Sixth Avenue	Denny Way	19.7	B	18.1	B
Seventh Avenue	Bell Street	13.8	B	11.2	B
Seventh Avenue	Blanchard Street	11.4	B	15.6	B
SR 99 NB On-ramp	Denny Way	15.6	B	13.8	B
SR 99 SB Off-ramp	Denny Way	18.8	B	51.4	D
Dexter Avenue	Denny Way	38.2	D	39.9	D

NB = northbound; SB = Southbound

4.3.2 Accessibility

Travelers' ability to reach (or access) destinations is the basic definition of the concept of *accessibility*. The various forms of accessibility described here include roadway connectivity and access, transit connectivity and coverage, freight access, pedestrian and bicycle access, and parking.

Roadway Connectivity and Access

SR 99 is a regional facility, but it primarily serves shorter regional trips and intracity trips. Between S. Spokane Street and the Battery Street Tunnel, all access is provided via ramps. North of the Battery Street Tunnel, arterial

connections to the SR 99 mainline provide access (right turns on and off only). This section describes the SR 99 corridor through the study area.

Travel Lanes

The SR 99 facility comprises two or more general-purpose lanes in each direction through the study area. Northbound, the SR 99 corridor carries three lanes from the Seneca Street off-ramp to the Western Avenue off-ramp. Two lanes continue northbound into the Battery Street Tunnel. The Battery Street Tunnel operates with two lanes in each direction. Exiting the tunnel northbound, the highway is joined by two additional lanes from Denny Way. The four-lane segment continues to Mercer Street, which is beyond the study area.

Southbound, three lanes are provided north of the Denny Way off-ramp at the Battery Street Tunnel. In this area north of the Battery Street Tunnel, the outside lane serves to collect and distribute right-turning vehicles to side streets. Through movements are primarily accommodated in the inside lanes. Two southbound lanes exit the Battery Street Tunnel and are joined by a third lane entering from Elliott Avenue.

Access to SR 99

Exhibit 4-21 summarizes the connections currently provided between SR 99 and other facilities within the study area. To summarize the quality of access that these connections provide, a qualitative rating system grades the degree (full access, partial access, or no access) and quality of connections (ranging from direct ramp connections to indirect connections).

In the Belltown area, an interchange at Western Avenue and Elliott Avenue provides full access to north downtown, Pike Place Market, and the waterfront, as well as access to arterials connecting to Interbay, Lower Queen Anne, Magnolia, and Ballard. The roadway and ramp geometrics for the Battery Street Tunnel southbound off-ramp and northbound on-ramp, which are near the south tunnel portal, limit overall use of these ramps.

The Denny Way ramps provide access to north downtown and a variety of locations to the east and west of SR 99 (South Lake Union, Seattle Center, Queen Anne, the north waterfront and Port of Seattle facilities), and are also the transit access point for all routes traveling on the corridor between downtown and points north.

Access in the South Lake Union area is provided by a number of right-on and right-off access points connecting to the local street grid. No left turns or at-grade crossings of SR 99 are allowed. Access at these locations is somewhat limited because the side streets enter at right angles, requiring that drivers accelerate from a stopped position or decelerate considerably before exiting SR 99.

Exhibit 4-21. Existing Connections

	Good Access	Partial or Substandard Access	No Access
SB SR 99 to Elliott/Western		Battery Street Tunnel off-ramp (substandard)	
Elliott/Western to SB SR 99	Elliott Avenue on-ramp		
NB SR 99 to Elliott/Western	Western Avenue off-ramp		
Elliott/Western to NB SR 99		Battery Street Tunnel on-ramp (substandard)	
SB SR 99 to west South Lake Union	Denny Way off-ramp Broad Street off-ramp	Arterial connections	
SB SR 99 to east South Lake Union	Denny Way off-ramp Broad Street off-ramp		
West South Lake Union to SB SR 99		Arterial connections	
East South Lake Union to SB SR 99			Indirect
NB SR 99 to west South Lake Union			Indirect
NB SR 99 to east South Lake Union	Mercer/Dexter off-ramp	Arterial connections	
West South Lake Union to NB SR 99		Arterial connections (via Mercer Street)	
East South Lake Union to NB SR 99	Denny Way on-ramp	Arterial connections	

NB = northbound; SB = southbound

Design Constraints

Lane widths, shoulder widths, acceleration and deceleration lanes, and other geometric features on SR 99 generally conform to a lesser standard than those found on newer highway facilities. Throughout the study area, the mainline provides narrow travel lanes and limited shoulders.

Speed Limits

Posted speed limits on the SR 99 mainline are shown in Exhibit 4-22.

Exhibit 4-22. Posted Speed Limits on SR 99 (miles per hour)

Mainline Segment	Posted Speed Limit (NB and SB)
North of Denny Way	40
Battery Street Tunnel	40 (35 advisory)
Elliott/Western Ramps to Seneca/Columbia Ramps	50

NB = northbound; SB = Southbound

Transit Connectivity and Coverage

No transit services use the Battery Street Tunnel. There is no direct access to the viaduct to and from the north in downtown Seattle, so transit routes serving the north end access SR 99 from Denny Way, or north of Denny Way via Dexter Avenue N.

Since HOV or transit-only facilities are not provided in the study area, transit routes are subject to the overall operating conditions and performance of the street network.

Freight Access

SR 99 through downtown Seattle serves areas that generate substantial freight and truck traffic. The City of Seattle has designated the south end of Ballard and the Interbay area as a manufacturing and industrial center. The Ballard Interbay Northend Manufacturing and Industrial Center (BINMIC) comprises 866 acres, with over 1,000 businesses employing 15,500 employees in 2005. Many of these businesses are located in this area due to its marine access. Commercial fishing and marine-related businesses such as ship repair are located here. In 2005, 31 percent of employment in the BINMIC was in manufacturing, 14 percent in wholesale trade (including warehousing), transportation, and utilities, and 13 percent in construction/resources (including fishing). Most BINMIC businesses are small businesses employing 40 or fewer employees. Rail access is provided at the BNSF Balmer Yard. The Port of Seattle also has facilities in the area at Terminals 86 and 91 and Fishermen's Terminal.

The BINMIC area is not served directly by the regional highway system. The primary access to regional freeways and industrial areas south of Seattle is via 15th Avenue W., connecting to SR 99 by way of the Elliott Avenue and Western Avenue ramps. Alternative routes include 15th Avenue W. or Nickerson Street and Westlake Avenue N. to N. Mercer Street and I-5; however, Mercer Street and I-5 provide a less direct and more congested route during most workdays. Freight generators in Ballard also use arterial east-west streets in Ballard and Fremont to access SR 99, including Leary Way and N. 39th Street, which is not designated as a Major Truck Street by the City of Seattle.

In addition to the industrial areas, trucks using the project corridor are destined for consumer markets throughout the city and the region.

Pedestrian and Bicycle Access

South of the Battery Street Tunnel, SR 99 is elevated as it passes over local streets and pedestrian facilities. The study area includes two major pedestrian facilities providing connections between downtown and the waterfront, the

Lenora Street Pedestrian Bridge and the Bell Street Pedestrian Bridge, which also connects to Alaskan Way and Elliott Avenue.

North of the Battery Street Tunnel, SR 99 divides the grid system and separates the South Lake Union area from Lower Queen Anne and the Seattle Center area. This segment of SR 99 is at-grade, and the only pedestrian crossings provided are at Denny Way and farther north outside the study area at Mercer and Broad Streets.

Pedestrians and bicycles may encounter heavy traffic and fast-moving vehicles at locations where traffic enters or exits SR 99. The Denny Way ramps are one location where vehicles encounter pedestrians immediately as they exit the highway. These ramps have sidewalks and buses along their outside lanes. This has been identified by WSDOT as a high pedestrian accident location, with four pedestrian accidents occurring between 1994 and 2000.

The Battery Street Tunnel ramps and Elliott Avenue/Western Avenue ramps also introduce highway traffic into a pedestrian environment with little transition. At the southbound on-ramp at Elliott Avenue and the northbound Battery Street Tunnel on-ramp, accelerating traffic entering the highway crosses pedestrian traffic traveling along Western or Elliott Avenues. The northbound off-ramp to Western Avenue accommodates high traffic volumes, which encounter an active pedestrian environment immediately at the base of the ramp. An unsignalized crosswalk at Bell Street crosses the ramp immediately as it joins the street grid. Both Western and Elliott Avenues experience moderate to high levels of pedestrian activity depending on the time of day.

Parking

Parking in the study area consists of on-street short-term parking and off-street parking (i.e., public pay lots). Some on-street parking and off-street parking would be affected during construction. The affected parking is described in Section 6.2.2, *Parking Effects*. Approximately 12 off-street spaces would not be replaced after construction. However, these spaces are private parking and are not available to the public, as described in Section 5.2.5, *Parking Effects*.

4.3.3 Safety

This safety discussion includes corridor design issues and collision history. Collision frequency, type, and severity were assessed for SR 99 extending from just north of the Western Avenue off-ramp/Elliott Avenue on-ramp to south of the Denny Way ramps, which includes the Battery Street Tunnel ramps and Battery Street Tunnel. The safety analysis was completed previously for the AWVSRP—this section is an excerpt of that work. The

collision evaluation for the Battery Street Tunnel can be found in more detail in the *SR 99 Battery Street Tunnel Collision Evaluation* (Parsons Brinckerhoff 2006b).

Corridor Design

SR 99 curves sharply at the south tunnel portal and again just inside of the north portal. The roadway superelevation and curvature conform to an approximate 35 mph design speed, but sight distance is limited to a 25 mph design speed standard (150 feet minimum) through these curves. The posted speed limit is 40 mph with a 35 mph posted advisory speed.

The Battery Street Tunnel ramps connect to SR 99 at the south tunnel portal. Horizontal and vertical alignments limit sight distance on the northbound on-ramp for both merging traffic and mainline traffic, as each traffic stream has poor visibility of the other. In addition, the on-ramp merges midcurve, without an acceleration lane, as the roadway enters the tunnel. Southbound, sight-distance on the off-ramp is limited as well, typically causing traffic to slow on the mainline prior to exiting.

Collision History

The segment of SR 99 studied extends from just north of the Western off-ramp/Elliott on-ramp to south of the Denny ramps, and includes the Battery Street Tunnel ramps and Battery Street Tunnel. An analysis of the collision data for this segment shows that over a 4-year period (2001–2004), 145 collisions occurred on the SR 99 mainline (73 northbound, 72 southbound), with an additional 18 collisions on the Battery Street Tunnel ramps. Sixteen of the ramp collisions were on the northbound on-ramp. In total, these collisions resulted in 80 injuries and one fatality.

Collision Rates

Collision frequency, expressed as the number of collisions per million vehicle-miles traveled (MVMT), is a standardized measure that is useful for comparing collision rates between different segments of SR 99. It can also be used to compare collision rates on different highways.

Collision rates were calculated for five primary segments on SR 99 between S. Spokane Street and Aloha Street and are described in more detail in the *SR 99 Collision Analysis* report (Parsons Brinckerhoff 2005b).

Segment collision rates were calculated for the mainline only, and also for the mainline plus adjacent ramp sections (Exhibits 4-23 and 4-24).

Exhibit 4-23. Collision Rates for Northbound SR 99 Segments (2000–2004)

Segment	Total Collisions per MVMT		Injury Collisions per MVMT	
	Mainline Only	Mainline and Ramps ¹	Mainline Only	Mainline and Ramps ¹
NB Spokane St - Stadiums	0.74	0.76	0.33	0.35
NB Stadiums - Downtown	2.03	2.24	0.60	0.74
NB Downtown - BST	1.02	1.56	0.37	0.75
NB Battery Street Tunnel	3.05	3.72	1.09	1.38
NB North of BST	2.31	2.37	0.80	0.80
SR 99 Corridor Average	1.51	1.71	0.54	0.65
Range ²	0.74–2.31	0.76–2.37	0.33–0.80	0.35–0.80

¹ Includes collisions on-ramps that occur within 250 feet of the mainline.

² Range of collision rates on other SR 99 segments (excludes Battery Street Tunnel segment).

Source: SR 99 Collision Analysis report (November 2005)

Exhibit 4-24. Collision Rates for Southbound SR 99 Segments (2000–2004)

Segment	Total Collisions per MVMT		Injury Collisions per MVMT	
	Mainline Only	Mainline and Ramps ¹	Mainline Only	Mainline and Ramps ¹
SB North of BST	2.04	2.27	0.57	0.63
SB Battery Street Tunnel	2.84	2.92	1.08	1.16
SB BST - Downtown	0.89	1.04	0.26	0.37
SB Downtown - Stadiums	3.37	3.73	1.14	1.24
SB Stadiums – Spokane St	0.73	0.78	0.36	0.41
SR 99 Corridor Average	1.50	1.64	0.55	0.62
Range ²	0.73–3.37	0.78–3.73	0.26–1.08	0.37–1.24

¹ Includes collisions on-ramps that occur within 250 feet of the mainline.

² Range of collision rates on other SR 99 segments (excludes Battery Street Tunnel segment).

Source: SR 99 Collision Analysis report (November 2005)

A relatively high number of collisions occur at the Battery Street Tunnel on-ramp, which has poor sight distance and merges quickly with the mainline on a sharp curve at the south end of the Battery Street Tunnel. Both mainline and ramp collisions are elevated at this location. A second increase in collision rates occurs at the north curve in the tunnel. Collision rates here are lower than in the south curve, but of similar magnitude to other high-collision locations on the corridor.

In the northbound direction, SR 99 was found to have an overall collision rate of 1.51 collisions per MVMT for the mainline only, and 1.71 for the mainline and connecting ramp segments. The northbound Battery Street Tunnel segment experiences a relatively high collision rate of 3.05 collisions per

MVMT for the mainline only, and 3.72 for the mainline and connecting ramp segments.

Southbound, the overall mainline collision rate is nearly identical to northbound: 1.50 collisions per MVMT. However, when both the mainline and connecting ramps are considered, the southbound collision rate is slightly lower than the northbound rate (1.64 versus 1.71 collisions per MVMT). The southbound Battery Street Tunnel segment has a higher than average collision rate with 2.84 collisions per MVMT for the mainline only, and 2.92 for the mainline and connecting ramp segments.

The *SR 99 Collision Analysis* report provides average collision rates for access-controlled roadways (freeways, expressways, and access-controlled urban arterials) in several states. These data show that average collision rates for freeways in Washington State are typically in the range of 1.32 to 1.60, lower than those reported for the Battery Street Tunnel segment of SR 99. Average rates reported in other states for expressways and urban controlled-access arterials—classifications that are more similar to the Alaskan Way Viaduct, but for which summary collision data are not available in Washington—ranged from 1.47 to 2.26. Average collision rates on urban principal arterials in Washington range from 2.41 to 2.97 (Parsons Brinckerhoff 2005b).

Collision Type

Fixed-object collisions are most prevalent on the Battery Street Tunnel segment, with rear-end and sideswipe collisions being the other primary crash types.

Northbound, the proportion of fixed-object and sideswipe collisions on the Battery Street Tunnel segment is higher than the corridor average, while the proportion of rear-end collisions is slightly lower. Fixed-object collisions account for 52 percent of northbound mainline collisions on the Battery Street Tunnel segment, compared to a corridor average of 37 percent. Rear-end crashes account for 26 percent of northbound Battery Street Tunnel mainline collisions, compared to a 30 percent corridor average. Sideswipe collisions account for 14 percent of northbound Battery Street Tunnel mainline collisions, compared to a 17 percent corridor average. Exhibit 4-25 summarizes the share of collisions by crash type for northbound SR 99.

Southbound, fixed-object collisions account for 49 percent of crashes on the Battery Street Tunnel segment, compared to a corridor average of 33 percent. Rear-end collisions account for 35 percent of southbound Battery Street Tunnel mainline collisions, compared to a 34 percent corridor average. Only 10 percent of southbound Battery Street Tunnel segment mainline collisions are sideswipe collisions, compared to a 20 percent corridor average. Exhibit 4-26 summarizes the share of collisions by crash type for southbound SR 99.

Fixed-object collisions on this segment tend to be associated with either excessive speed in curves (relative to the curve radius, road surface friction, and superelevation), or proximity of roadside objects (curbs, attenuators, or tunnel walls) to the travel lane. Rear-end collisions may be associated with a number of factors, including excessive speed, merging traffic, congestion, or sight-distance limitations. Sideswipe collisions can result when vehicles stray from their travel lane or make abrupt lane changes.

Exhibit 4-25. Mainline Collision Types for Northbound SR 99 Segments

Segment	Collision Types			
	Fixed-Object	Rear-End	Sideswipe	Unknown/ Other ¹
NB Battery Street Tunnel	52%	26%	14%	8%
NB SR 99 Corridor Average	37%	30%	17%	16%

¹ Enter-at-angle, pedestrian, roll over, wrong direction of travel, or unknown/unclassified.

Exhibit 4-26. Mainline Collision Types for Southbound SR 99 Segments

Segment	Collision Types			
	Fixed-Object	Rear-End	Sideswipe	Unknown/ Other ¹
SB Battery Street Tunnel	49%	35%	10%	6%
SB SR 99 Corridor Average	33%	34%	20%	13%

¹ Enter-at-angle, pedestrian, roll over, wrong direction of travel, or unknown/unclassified.

Collision Severity

Northbound, 36 percent of collisions on the Battery Street Tunnel segment involve injuries or possible injuries, compared to a corridor average of 36 percent. Southbound, a slightly higher share of collisions—38 percent—involve possible injuries, compared to a corridor average of 36 percent. Most of these were categorized as “possible injury” collisions; the proportion of collisions that result in more severe injuries is slightly lower than the corridor average (9 percent evident injuries on the Battery Street Tunnel segment compared to 11 percent for the corridor average).

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Chapter 5 OPERATIONAL EFFECTS AND BENEFITS

To gauge potential effects to the transportation system and assess transportation performance, SR 99 and related transportation systems were analyzed with and without the Project under 2030 forecasted conditions. As outlined in Section 2.3, these future transportation system conditions were established based on forecasts of regional population and employment, socioeconomic conditions, and transportation system pricing (parking, tolls, fares) developed by PSRC and reflected in its EMME/2 travel demand model. The 2030 Build Alternative reflects projected conditions, assuming the Project is in place.

The project team investigated a 2030 Baseline Scenario that presumes SR 99's current configuration against the backdrop of forecasted 2030 conditions. This scenario serves to establish baseline information for system performance, against which conditions for the Project may be compared.

These future conditions presume a limited number of new transportation facilities and services by 2030, under both the 2030 Build Alternative and the 2030 Baseline Scenario. The new transportation system components in the 2030 Baseline Scenario include the SR 99: S. Holgate Street to S. King Street Viaduct Replacement Project. The baseline assumptions are listed in Section 2.3.2.

In addition to the 2030 Baseline and 2030 Build Alternative conditions, year-of-opening (2011) conditions are evaluated in Section 5.4.

5.1 Mobility

Mobility measures include travel demand and traffic patterns and AM and PM peak-hour traffic operations for the forecast year. Refer to Section 5.4 for year-of-opening mobility information. Effects and benefits for each measure are described in the following sections.

5.1.1 Travel Demand and Traffic Patterns

Key Findings

- With the closure of the Battery Street Tunnel northbound on-ramp and southbound off-ramp at Western Avenue, higher ramp volumes in the South Lake Union area are expected, along with lower volumes in the Battery Street Tunnel in both directions. Volumes at the Denny Way ramps are expected to increase slightly under the Build Alternative. These changes in traffic volumes would affect traffic operations, as discussed in Section 5.1.2.

Alaskan Way Viaduct (SR 99) Users

The project team developed detailed AM and PM peak-hour traffic estimates for the 2030 Baseline Scenario and the Build Alternative for SR 99 through the study area. Traffic volumes are presented for each connection to SR 99 (ramps or side streets) and for each mainline segment (section of SR 99 between connections). The project team estimated year 2030 traffic volumes based on current volumes, which were adjusted to reflect the growth and traffic redistribution forecasted by the AWW model. In general, peak hour growth in traffic volumes for SR 99 and its ramps within the study area were minimal.

2030 Baseline Mainline and Ramp Volumes – AM Peak Hour

Traffic volumes on the SR 99 corridor are highest during commuting hours. In the morning, peak-hour traffic volumes on SR 99 are directional, with heavier volumes entering the central downtown. AM and PM peak-hour mainline and ramp volumes forecasted for the 2030 Baseline Scenario are shown in Exhibit 5-1.

AM peak hour mainline volumes within the study area are higher in the southbound direction, as more vehicles are entering the downtown area (4,710 vehicles) than are leaving it (3,040 vehicles). Similarly, southbound off-ramp volumes at Denny Way (1,230 vehicles) exceed those on the northbound on-ramp (450 vehicles). In the Battery Street Tunnel, the volumes are fairly balanced, with the northbound vehicles (3,250 vehicles) slightly exceeding the volume of southbound vehicles (3,130 vehicles). The ramps at Elliott and Western Avenues providing access to and from the north show directionality as well, with 410 vehicles exiting southbound on the Battery Street Tunnel off-ramp and only 150 vehicles entering northbound on the Battery Street Tunnel on-ramp. The ramps to and from the south show directionality as well, with 1,150 vehicles entering southbound and 1,345 vehicles exiting northbound.

2030 Baseline Mainline and Ramp Volumes – PM Peak Hour

Similar to the AM peak, PM peak-hour traffic volumes along SR 99 are directional, with heavier volumes leaving the downtown area (4,990 vehicles) than are entering it (3,870 vehicles), as shown in Exhibit 5-1. Northbound on-ramp volumes at Denny Way (1,350 vehicles) exceed those on the southbound off-ramp (700 vehicles). In the Battery Street Tunnel, the volume of northbound vehicles (3,820 vehicles) again exceeds the volume of southbound vehicles (3,270 vehicles). The Battery Street Tunnel ramps, which provide access to and from the north, show directionality as well, with 490 vehicles entering northbound but only 200 vehicles exiting southbound. The ramps to and from the south at Elliott and Western Avenues are fairly balanced, with 1,350 vehicles entering southbound and 1,340 vehicles exiting northbound.

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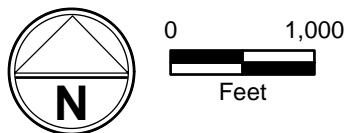
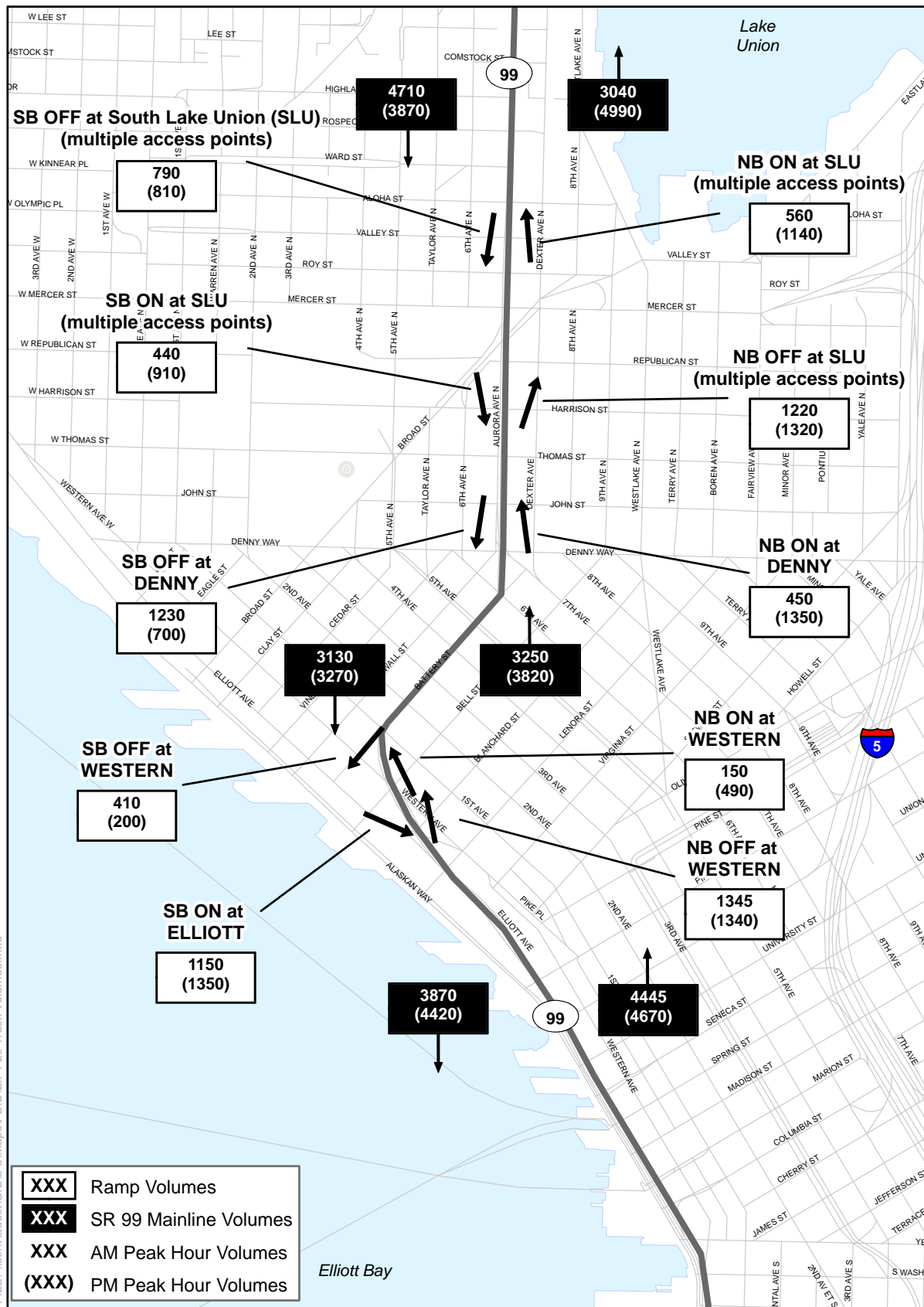


Exhibit 5-1
2030 Baseline
SR 99 Mainline and Ramp Volumes
AM and PM Peak Hour

2030 Build Alternative Mainline and Ramp Volumes – AM and PM Peak Hours

The 2030 AM and PM peak-hour mainline and ramp volumes forecasted for the Build Alternative are shown in Exhibit 5-2.

Because the Build Alternative would close the Battery Street Tunnel northbound on-ramp and southbound off-ramp just south of the tunnel portal, slightly higher peak hour on-ramp volumes at Denny Way and lower volumes in the Battery Street Tunnel in both directions are expected compared to the 2030 Baseline Scenario. For the majority of drivers who would have used the Battery Street Tunnel ramps on the south end of the tunnel, the Denny Way ramps would provide the most convenient alternatives due to proximity and accessibility to destinations. Vehicles that currently use the Battery Street Tunnel ramps would therefore be expected to shift to using the Denny Way on- and off-ramps, as reflected in the traffic volume figures shown in Exhibit 5-2. Volumes at the northbound off-ramp at Western Avenue and the southbound on-ramp at Elliott Avenue would likely be similar to the 2030 Baseline Scenario, with some slight differences. Volume projections from the model are not exact, and small variations in volumes at these ramps can be expected.

Arterial and Local Street Forecasts

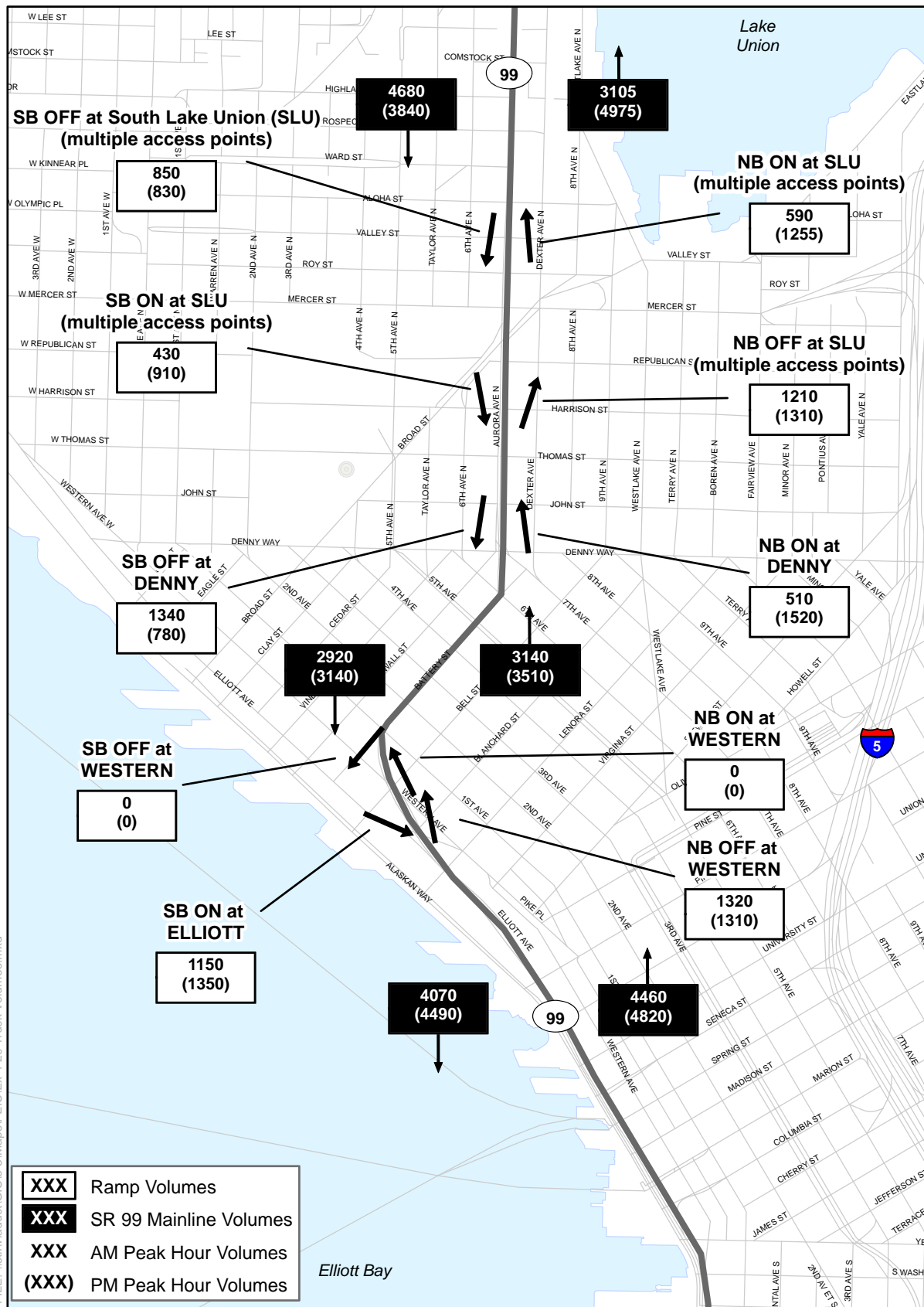
To analyze traffic operations, the project team developed traffic estimates for selected links and intersections on arterials and local streets within the study area. The intersections selected for study are shown in Exhibit 2-2 (Chapter 2).

5.1.2 Traffic Operations

Key Findings

- The Project would provide a benefit for portions of northbound and southbound SR 99 in the study area by reducing traffic volumes and improving LOS and speeds.
- The Project is not expected to negatively affect LOS conditions at study area intersections during the 2030 AM peak hour. Most intersections are expected to continue to operate at LOS D or better. Intersections already operating below LOS D during the AM peak hour with the 2030 Baseline Scenario are not expected to degrade any further under the Build Alternative.
- During the PM peak hour, changes in traffic patterns are expected to worsen congested conditions at some study area intersections.
- Operations at the Western Avenue/Battery Street intersection are expected to improve due to the closure of the southbound Battery Street Tunnel ramp.

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Exhibit 5-2
2030 Build Alternative
SR 99 Mainline and Ramp Volumes
AM and PM Peak Hour

SR 99 Mainline Level of Service

This section presents the AM and PM peak-hour LOS for corridor segments under the 2030 Baseline Scenario and the Build Alternative. As described in Chapter 2, LOS is a standard measure of intersection performance that describes the degree of congestion forecasted. LOS is measured on a scale from A (best level of service, representing free-flow conditions), to F (very congested breakdown conditions).

Mainline traffic performance was modeled using VISSIM simulation software. LOS for mainline and ramp operations is calculated based on speed and density, as observed in the VISSIM model. Although LOS can indicate how a facility performs overall, it is not always a straightforward means of comparing scenarios, because ramp and segment arrangements vary among the scenarios.

2030 Baseline Level of Service

Exhibits 5-3 and Exhibit 5-4 show the SR 99 mainline LOS by segment for the existing facility, for year 2030 travel demands during the AM and PM peak hours, respectively. The corridor is expected to operate mostly under LOS E or F conditions by 2030, with a few exceptions. During the AM peak hour in the northbound direction from Battery Street Tunnel to north of Broad Street, LOS D or better conditions are forecasted. In the southbound direction during the AM peak hour, LOS D conditions are forecasted south of the Elliott Avenue on-ramp. During the PM peak hour, LOS D conditions are forecasted in the southbound direction north of Battery Street Tunnel and south of the Elliott Avenue on-ramp.

Exhibit 5-3. 2030 Baseline AM Peak Hour SR 99 Segment LOS

Southbound			Northbound	
North of Broad Street	F	C	North of Broad Street	
Broad Street to Battery Street Tunnel	F	D	Battery Street Tunnel to Broad Street	
Battery Street Tunnel	F	F	Battery Street Tunnel	
Battery Street Tunnel to Elliott On-ramp	E	F	Western Off-ramp to Battery Street Tunnel	
South of Elliott On-ramp	D	E	South of Western Off-ramp	

Exhibit 5-4. 2030 Baseline PM Peak Hour SR 99 Segment LOS

Southbound			Northbound	
North of Broad Street	D	E	North of Broad Street	
Broad Street to Battery Street Tunnel	D	F	Battery Street Tunnel to Broad Street	
Battery Street Tunnel	E	F	Battery Street Tunnel	
Battery Street Tunnel to Elliott On-ramp	F	F	Western Off-ramp to Battery Street Tunnel	
South of Elliott On-ramp	D	E	South of Western Off-ramp	

Build Alternative Level of Service

The closure of the Battery Street Tunnel ramps is expected to affect traffic operations with the Build Alternative. Exhibits 5-5 and 5-6 show the SR 99 mainline LOS by segment for the Build Alternative. As a whole, mainline traffic operations for the Build Alternative would be comparable to the 2030 Baseline Scenario. Changes in LOS are forecasted along several segments under the Build Alternative. During the 2030 AM peak hour, the segment in the Battery Street Tunnel in the southbound direction is forecasted to improve from LOS F with the Baseline Scenario to LOS D with the Build Alternative. Traffic volumes are forecasted to decrease through the Battery Street Tunnel (due to the closure of the Battery Street Tunnel ramps) and speeds are expected to increase, causing LOS to improve in the southbound direction.

Speeds are expected to remain the same during the AM peak hour through the Battery Street Tunnel in the northbound direction. Traffic volumes are forecasted to decrease in the northbound direction, but not to the same extent as in the southbound direction. Therefore, LOS is not expected to change between the Baseline and the Build Alternative during the 2030 AM peak hour in the northbound direction.

During the 2030 PM peak hour, the segment of SR 99 between the Battery Street Tunnel and Broad Street in the northbound direction is forecasted to improve from LOS F with the Baseline to LOS E with the Build Alternative. The Battery Street Tunnel is expected to continue to operate at LOS E or F for the Build Alternative, similar to the Baseline condition. The reduction in traffic volume that results from closing the Battery Street Tunnel ramps is not great enough to alter LOS in the 2030 PM peak hour.

Exhibit 5-5. Build Alternative (2030) AM Peak Hour SR 99 Segment LOS

Southbound			Northbound	
North of Broad Street	F	C	North of Broad Street	
Broad Street to Battery Street Tunnel	F	D	Battery Street Tunnel to Broad Street	
Battery Street Tunnel	D	F	Battery Street Tunnel	
Battery Street Tunnel to Elliott On-ramp	E	F	Western Off-ramp to Battery Street Tunnel	
South of Elliott On-ramp	D	E	South of Western Off-ramp	

Exhibit 5-6. Build Alternative (2030) PM Peak Hour SR 99 Segment LOS

Southbound			Northbound	
North of Broad Street	D	E	North of Broad Street	
Broad Street to Battery Street Tunnel	D	E	Battery Street Tunnel to Broad Street	
Battery Street Tunnel	E	F	Battery Street Tunnel	
Battery Street Tunnel to Elliott On-ramp	F	F	Western Off-ramp to Battery Street Tunnel	
South of Elliott On-ramp	D	E	South of Western Off-ramp	

SR 99 Mainline Speeds

This section presents the AM and PM peak hour travel speeds for corridor segments for the 2030 Baseline Scenario and the Build Alternative. Mainline traffic speeds were modeled using VISSIM simulation software. Travel speed results for the corridor segments confirm the LOS findings for the 2030 Baseline Scenario. The results show congested conditions causing slow speeds on the existing facility in 2030 in the southbound direction and on portions of the northbound direction during the AM peak (Exhibit 5-7). During the 2030 Baseline PM peak, slow speeds occur in the northbound direction and portions of the southbound direction (Exhibit 5-8).

Under the Build Alternative (Exhibits 5-9 and 5-10), peak period travel speeds are generally expected to be the same as for the 2030 Baseline Scenario, although speeds are expected to increase through the Battery Street Tunnel in the southbound direction during the 2030 AM peak hour. Speeds are also expected to increase in the northbound direction along the segment between the Western Avenue off-ramp and the Battery Street Tunnel during the PM peak hour. These increases in speeds are due to the decreases in volumes on SR 99 as a result of closing the Battery Street Tunnel ramps.

Exhibit 5-7. 2030 Baseline AM Peak Hour SR 99 Segment Speeds

Southbound			Northbound	
North of Broad Street	34	40	North of Broad Street	
Broad Street to Battery Street Tunnel	34	40	Battery Street Tunnel to Broad Street	
Battery Street Tunnel	28	33	Battery Street Tunnel	
Battery Street Tunnel to Elliott On-ramp	36	25	Western Off-ramp to Battery Street Tunnel	
South of Elliott On-ramp	48	37	South of Western Off-ramp	

Exhibit 5-8. 2030 Baseline PM Peak Hour SR 99 Segment Speeds

Southbound			Northbound	
North of Broad Street	40	34	North of Broad Street	
Broad Street to Battery Street Tunnel	41	37	Battery Street Tunnel to Broad Street	
Battery Street Tunnel	42	33	Battery Street Tunnel	
Battery Street Tunnel to Elliott On-ramp	36	18	Western Off-ramp to Battery Street Tunnel	
South of Elliott On-ramp	48	42	South of Western Off-ramp	

Exhibit 5-9. Build Alternative (2030) AM Peak Hour SR 99 Segment Speeds

Southbound			Northbound	
North of Broad Street	35	40	North of Broad Street	
Broad Street to Battery Street Tunnel	32	39	Battery Street Tunnel to Broad Street	
Battery Street Tunnel	41	33	Battery Street Tunnel	
Battery Street Tunnel to Elliott On-ramp	35	25	Western Off-ramp to Battery Street Tunnel	
South of Elliott On-ramp	47	38	South of Western Off-ramp	

Exhibit 5-10. Build Alternative (2030) PM Peak Hour SR 99 Segment Speeds

Southbound			Northbound	
North of Broad Street	40	35	North of Broad Street	
Broad Street to Battery Street Tunnel	38	37	Battery Street Tunnel to Broad Street	
Battery Street Tunnel	42	33	Battery Street Tunnel	
Battery Street Tunnel to Elliott On-ramp	35	24	Western Off-ramp to Battery Street Tunnel	
South of Elliott On-ramp	48	42	South of Western Off-ramp	

Arterial Traffic Performance

To assess the effects of the 2030 Baseline Scenario and the 2030 Build Alternative on the broader transportation system, the project team analyzed intersection operations at adjacent and nearby intersections. Traffic operations on other study area streets and highways can be affected by either redistribution effects caused by changes to corridor capacity (as described in the previous section), or by relocation of access points to the SR 99 corridor, which affects how traffic distributes to and from the SR 99 corridor.

Because most intersections in the study area are signalized, the analysis in this section focuses solely on signalized intersections.

This section discusses the results of the Synchro analysis. Exhibits 5-11 and 5-12 compare the results of the following analysis scenarios for the AM and PM peak hours: 2005 Existing Conditions, 2030 Baseline Scenario, and the 2030 Build Alternative.

Exhibit 5-11. Signalized Intersection Level of Service

Street	Cross Street	2005 Existing	2030 Baseline	2030 Build	2005 Existing	2030 Baseline	2030 Build
		AM PEAK HOUR			PM PEAK HOUR		
Western Avenue	Battery Street	B	B	A	B	B	A
Western Avenue	Wall Street	C	D	D	C	E	E
First Avenue	Wall Street	B	B	B	C	D	D
Second Avenue	Wall Street	B	B	B	B	B	B
Third Avenue	Wall Street	B	B	B	B	C	C
Fourth Avenue	Wall Street	C	C	C	A	A	A
Fourth Avenue	Battery Street	B	C	C	C	E	E
Fourth Avenue	Bell Street	A	A	A	B	B	B
Fourth Avenue	Blanchard Street	A	B	B	B	B	B
Fifth Avenue	Wall Street	A	C	C	B	B	B
Fifth Avenue	Battery Street	B	C	C	C	E	F
Fifth Avenue	Bell Street	B	B	B	B	C	C
Fifth Avenue	Blanchard Street	A	A	A	B	B	B
Fifth Avenue	Denny Way	C	C	C	B	C	C
Fifth Avenue	Broad Street	D	F	F	C	D	D
Sixth Avenue	Wall Street	A	B	B	A	A	A
Sixth Avenue	Battery Street	B	B	B	C	E	F
Sixth Avenue	Bell Street	B	B	B	B	C	C
Sixth Avenue	Blanchard Street	A	A	A	B	C	C
Sixth Avenue	Denny Way	B	C	C	B	C	C
Seventh Avenue	Bell Street	B	B	B	B	B	B
Seventh Avenue	Blanchard Street	B	B	B	B	C	C
SR 99 SB Off-ramp	Denny Way	B	B	D	B	C	D
SR 99 NB On-ramp	Denny Way	B	C	C	D	E	F
Dexter Avenue	Denny Way	D	E	E	D	E	F

Exhibit 5-12. Signalized Intersection Average Vehicle Delay (seconds)

Street	Cross Street	2005 Existing	2030 Baseline	2030 Build	2005 Existing	2030 Baseline	2030 Build
		AM PEAK HOUR			PM PEAK HOUR		
Western Avenue	Battery Street	17.7	19.5	<1.0	11.0	11.0	<1.0
Western Avenue	Wall Street	21.1	52.0	52.0	29.5	77.8	77.8
First Avenue	Wall Street	18.7	19.7	19.4	22.2	37.3	37.3
Second Avenue	Wall Street	11.9	13.4	13.4	14.9	17.6	18.1
Third Avenue	Wall Street	10.5	11.0	10.7	19.3	21.9	22.5
Fourth Avenue	Wall Street	22.5	23.0	22.7	4.3	5.3	5.4
Fourth Avenue	Battery Street	21.3	22.0	21.4	20.1	59.5	74.4
Fourth Avenue	Bell Street	4.2	4.2	4.2	10.0	13.2	13.1
Fourth Avenue	Blanchard Street	9.2	10.0	10.2	14.5	17.9	18.9
Fifth Avenue	Wall Street	16.6	20.7	23.4	11.4	13.1	12.7
Fifth Avenue	Battery Street	17.9	21.8	23.9	21.0	69.9	82.8
Fifth Avenue	Bell Street	11.3	15.3	15.6	15.7	21.0	21.0
Fifth Avenue	Blanchard Street	6.1	8.1	8.4	11.4	13.2	13.5
Fifth Avenue	Denny Way	24.4	29.5	31.7	17.8	20.8	21.1
Fifth Avenue	Broad Street	49.7	82.8	97.4	34.2	38.8	39.7
Sixth Avenue	Wall Street	9.7	11.2	10.9	5.7	6.8	7.3
Sixth Avenue	Battery Street	15.9	16.5	17.2	25.8	73.2	109.9
Sixth Avenue	Bell Street	16.5	19.3	19.0	14.6	20.9	20.7
Sixth Avenue	Blanchard Street	7.7	7.7	7.4	19.6	21.8	22.9
Sixth Avenue	Denny Way	19.7	24.0	25.7	18.1	23.8	24.0
Seventh Avenue	Bell Street	13.8	15.1	15.2	11.2	14.3	14.3
Seventh Avenue	Blanchard Street	11.4	12.1	11.6	15.6	20.1	22.9
SR 99 SB Off-ramp	Denny Way	15.6	17.4	37.1	13.8	29.5	39.2
SR 99 NB On-ramp	Denny Way	18.8	20.5	26.3	51.4	76.2	98.1
Dexter Avenue	Denny Way	38.2	68.3	72.9	39.9	76.3	85.1

Synchro Observations

Vehicles that currently use the Battery Street Tunnel ramps in the existing conditions and the 2030 Baseline Scenario are expected to reroute to use the Denny Way ramps. For the majority of drivers using the Battery Street Tunnel ramps, the Denny Way ramps would provide the most convenient alternative due to proximity and accessibility to destinations. Vehicles that currently use the Battery Street Tunnel ramps would therefore be expected to shift to using the Denny Way on- and off-ramps as reflected in the traffic volume figures. This rerouting of traffic is expected to affect several intersections in the study area.

The intersection of Western Avenue/Battery Street is expected to improve from LOS B under the 2030 Baseline Scenario to LOS A under the 2030 Build Alternative during the AM and PM peak hours. Closing the Battery Street Tunnel southbound off-ramp would reduce volumes at this intersection, removing any conflicting movements at this intersection. This intersection would essentially operate at free-flow northbound along Western Avenue.

Therefore, the City of Seattle may want to consider removing the existing signal at this intersection.

LOS D represents traffic operations that are near capacity. During the AM peak hour, all of the study intersections are expected to operate at LOS D or better during the year 2030, with two exceptions. The intersection of Fifth Avenue/Broad Street is expected to operate at LOS F with the 2030 Baseline as well as with the 2030 Build Alternative. Additionally, the intersection of Dexter Avenue/Denny Way is expected to operate at LOS E with either the Baseline or Build Alternative during the 2030 AM peak hour.

The majority of study intersections are expected to operate at LOS D or better during the 2030 PM peak hour. However, the intersections of Fifth Avenue/Battery Street, Sixth Avenue/Battery Street, SR 99 southbound off-ramp/Denny Way, and Dexter Avenue/Denny Way are expected to degrade to LOS E with the 2030 Baseline and to LOS F with the 2030 Build Alternative.

The additional volume expected at these intersections with the 2030 Build Alternative is forecasted to be less than 4 percent. However, these intersections are forecasted to operate under congested conditions with the 2030 Baseline (LOS E), so the small additional volume is expected to further degrade operations to LOS F (breakdown conditions) at these locations.

Modified signal operations at the Sixth Avenue/Denny Way and Dexter Avenue/Denny Way intersections are included in the recommended SR 99/Initial Transit Enhancements and Other Improvements (described in Section 6.3.1). These projects would help mitigate safety, accessibility, and mobility concerns that may result from construction of the five other AWVSRP Moving Forward projects.

Possible mitigation measures to improve traffic operations at Fifth Avenue/Battery Street could include signal optimization. Changes in signal timing would need to be coordinated with and approved by SDOT prior to implementation.

A possible mitigation measure for the intersection of the Denny Way/SR 99 northbound on-ramp would be to eliminate the southbound left turns from SR 99 to Denny Way. This traffic could be redirected southbound across Denny Way, then back to locations east through a series of right turns.

Effects to Specific Sensitive Areas

Fire Station No. 2, on the corner of Battery Street and Fourth Avenue, is an important emergency services facility. Traffic operations on Battery Street and on connecting east-west arterials could slightly affect response time during the PM peak hour. Egress from this fire station under the Build Alternative is expected to be similar to the Baseline Scenario.

The Build Alternative is not expected to cause LOS conditions at study area intersections to degrade below LOS D during the 2030 AM peak hour. Intersections already operating below LOS D during the AM peak hour with the 2030 Baseline Scenario are not expected to degrade any further under the Build Alternative. However, during the PM peak hour, changes in traffic patterns are expected to worsen congested conditions at some study area intersections, including the intersection at Fourth Avenue and Battery Street.

5.2 Accessibility

Accessibility measures include roadway connectivity and access, transit connectivity and coverage, freight access, and pedestrian and bicycle access.

5.2.1 Roadway Connectivity and Access

Key Findings

- The Project would close the Battery Street Tunnel ramps, which would eliminate access to northbound SR 99 from Elliott/Western Avenues and from southbound SR 99 to Elliott/Western Avenues. These ramps are lightly used and cannot be updated to current geometric standards. They would be closed and used for maintenance and emergency access only.

This section assesses the connections provided between the SR 99 corridor and other streets in the study area. Exhibits 5-13 and 5-14 list connections to and from SR 99 for the existing facility in the study area and the proposed Project.

Exhibit 5-13. Connections Provided to and from SR 99 – Existing Facility

Connection From/To	Good Access	Partial or Substandard Access	No Access
Elliott and Western Corridor			
SB SR 99 to Elliott/Western		Battery Street Tunnel off-ramp (substandard)	
Elliott/Western to SB SR 99	Elliott Avenue on-ramp		
NB SR 99 to Elliott/Western	Western Avenue off-ramp		
Elliott/Western to NB SR 99		Battery Street Tunnel on-ramp (substandard)	
South Lake Union Area			
SB SR 99 to west South Lake Union	Denny Way off-ramp Broad Street off-ramp	Arterial connections	
SB SR 99 to east South Lake Union	Denny Way off-ramp Broad Street off-ramp		
West South Lake Union to SB SR 99		Arterial connections	

**Exhibit 5-13. Connections Provided to and from SR 99 – Existing Facility
(continued)**

Connection From/To	Good Access	Partial or Substandard Access	No Access
East South Lake Union to SB SR 99			Indirect
NB SR 99 to west South Lake Union			Indirect
NB SR 99 to east South Lake Union	Mercer/Dexter off-ramp	Arterial connections	
West South Lake Union to NB SR 99		Arterial connections (via Mercer Street)	
East South Lake Union to NB SR 99	Denny Way on-ramp	Arterial connections	

Exhibit 5-14. Connections Provided to and from SR 99 – Proposed Project

Connection From/To	Good Access	Partial or Substandard Access	No Access
Elliott and Western Corridor			
SB SR 99 to Elliott/Western			None
Elliott/Western to SB SR 99	Elliott Avenue on-ramp		
NB SR 99 to Elliott/Western	Western Avenue off-ramp		
Elliott/Western to NB SR 99			None
South Lake Union Area			
SB SR 99 to west South Lake Union	Denny Way off-ramp Broad Street off-ramp	Arterial connections	
SB SR 99 to east South Lake Union	Denny Way off-ramp Broad Street off-ramp		
West South Lake Union to SB SR 99		Arterial connections	
East South Lake Union to SB SR 99			Indirect
NB SR 99 to west South Lake Union			Indirect
NB SR 99 to east South Lake Union	Mercer/Dexter off-ramp	Arterial connections	
West South Lake Union to NB SR 99		Arterial connections (via Mercer Street)	
East South Lake Union to NB SR 99	Denny Way on-ramp	Arterial connections	

To and From Belltown/Interbay

The northbound off-ramp to Western Avenue and southbound on-ramp from Elliott Avenue would be maintained under the Project.

The lightly used Battery Street Tunnel ramps immediately adjacent to the Battery Street Tunnel would be closed to general traffic but maintained for maintenance and emergency access. Both of these ramps have geometric deficiencies, including short deceleration/acceleration sections and poor sight distances. Trips that currently use these ramps could instead access SR 99 at the Denny Way ramps or the ramps in the South Lake Union area.

5.2.2 Transit Connectivity and Coverage

The Project would not result in any changes to transit connectivity or coverage after construction is completed. Transit would continue to use the Denny Way ramps as it does today.

5.2.3 Freight Access

Key Findings

- Freight connections to the BINMIC would still be provided from the Elliott/Western ramps. An anticipated benefit of the Project would be improved operations compared to the existing facility due to improved ramp configurations and the elimination of cross traffic from the Battery Street Tunnel ramps.

Freight Connections

The Project would maintain the northbound off-ramp to Western Avenue and southbound on-ramp from Elliott Avenue. Travel time to the BINMIC would likely be improved compared to the existing configuration due to closure of the Battery Street Tunnel ramps. Closure of the southbound ramp would remove westbound vehicles from the intersection of Western Avenue/Battery Street. The removal of these volumes would reduce delay for northbound vehicles traveling along Western Avenue. This would reduce delays for freight connections from the Western Avenue off-ramp heading towards the BINMIC.

Ability of Design to Facilitate Freight Operations

Restrictions on the transport of hazardous and flammable materials are expected to be similar to or the same as those in place today, with peak period restrictions on the viaduct for vehicles carrying hazardous materials and full prohibition in the Battery Street Tunnel. Even with the fire and safety improvements, the current restrictions on hazardous materials are not expected to be removed or even reduced.

Primary alternate routes for flammable and hazardous materials are the Alaskan Way surface street or I-5. Typically, diversion to Alaskan Way would add 5 to 10 minutes to a trip compared to using SR 99.

5.2.4 Pedestrian and Bicycle Access

Key Findings

- No changes to bicycle and pedestrian facilities are proposed as part of this Project. A benefit of the Battery Street Tunnel ramp closures is that the potential for conflicts between pedestrians and bicyclists at the ramps would be reduced.

There are no proposed changes to pedestrian or bicycle facilities in the study area. Pedestrians and bicyclists are prohibited from using the Battery Street Tunnel. The Project would add one new emergency egress in the tunnel at an approximate midpoint of the southbound bore. However, tunnel egress is provided for emergency use only, so it is not considered a pedestrian improvement.

The Project would install gates on the Battery Street Tunnel on- and off-ramps. These gates would prevent vehicles from using the ramps while providing emergency service providers with access in certain situations. Currently, there is a crosswalk at the signalized intersection where the southbound Battery Street Tunnel off-ramp connects with Western Avenue. There is no crosswalk or signal currently provided at the northbound Battery Street Tunnel on-ramp. Closure of these ramps would reduce the potential for conflicts between vehicles and pedestrians and bicyclists who cross at the ramp locations.

5.2.5 Parking Effects

Approximately 12 off-street spaces would be permanently removed in a private parking lot on the northeast corner of Battery Street and Third Avenue. These spaces are currently private parking spaces and are not available to the public.

5.3 Safety

Key Findings

- The planned closure of the Battery Street Tunnel ramps is expected to reduce collisions substantially (particularly northbound) in the vicinity of the Battery Street Tunnel, which is a key benefit of the Project.
- Improvements to the Battery Street Tunnel, such as improved lighting and installation of new signing and striping, are anticipated to help regulate speeds and increase driver awareness of tunnel conditions.

Battery Street Tunnel Ramp Closure

A large number of collisions were found to be associated with the Battery Street Tunnel ramps, particularly the northbound on-ramp. The SR 99 Battery

Street Tunnel Collision Evaluation (Parsons Brinckerhoff 2006b) discussed the potential reduction in collision rates associated with closing the Battery Street Tunnel ramps. Closing the on-ramp is expected to substantially reduce collision rates in the northbound direction, perhaps by as much as 26 to 31 percent when collisions on the mainline and the merging ramp are considered. Southbound collision rates could be reduced more modestly by closing the Battery Street Tunnel off-ramp: by an estimated 4 to 5 percent.

Closing the Battery Street Tunnel ramps would potentially reduce the incidence of a number of collision types:

- Northbound sideswipe collisions may result from abrupt lane changes to avoid merging vehicles (or in anticipation of merging traffic), or could occur between merging traffic and traffic in the outside travel lane.
- Northbound rear-end collisions in the outside lane may also be related to merging ramp traffic. Rear-end collisions that occur prior to the Battery Street Tunnel on-ramp may occur when a mainline vehicle slows to allow merging vehicles into traffic. Rear-end collisions can also occur at or immediately after the on-ramp between fast-moving traffic in the outside lane and slower vehicles that have just merged onto the mainline.
- Southbound rear-end collisions or sideswipes (outside lane to inside) resulting from decelerating traffic using the off-ramp.
- Collisions on the ramps themselves.

While the recent collision history indicates that crashes that may be associated with the Battery Street Tunnel ramps tend to have relatively low severity, closure of these ramps is nonetheless recommended due primarily to the frequency with which these collisions occur.

Battery Street Tunnel Improvements

Several of the proposed improvements to the Battery Street Tunnel are expected to help reduce collisions. Improved signage could help improve recognition of and compliance with the posted advisory speed of 35 mph. New variable message signs at the north and south portals, and in advance of the tunnel entry, would alert drivers of incidents or conditions of which to be aware.

Edge-line pavement markings are often not visible in the Battery Street Tunnel due to an accumulation of soot and dirt. This results in an appearance of wide lanes (12.5 feet) adjacent to raised curbs with no shoulder. Restriping the edge line and more frequent sweeping in the tunnel would draw attention to the edge of the roadway and result in visually narrower lanes of 11 to

11.5 feet (though the actual pavement width would be unchanged), which may help regulate travel speeds through the tunnel. A wider than normal edge-line and/or reflective road markers could be used to emphasize the edge of the roadway. These improvements could help reduce fixed-object collisions.

The Project would provide improved lighting and add new reflective epoxy paint on the tunnel walls. Improved tunnel lighting would allow drivers to better identify the edge of the roadway and ease the transition between daylight and tunnel lighting. Reflective paint could improve visibility and may be an effective countermeasure to sight distance limitations within the tunnel by allowing drivers to see brake light activity indirectly beyond the direct line of sight.

5.4 Year of Opening Conditions

According to the current conceptual construction schedule for the Project, the opening year is assumed to be 2011. This section discusses mobility measures, including travel demand, traffic patterns, and traffic operations for the Year of Opening Baseline and Build Alternative. For a discussion of 2005 Existing Conditions, refer to Chapter 4.

5.4.1 Travel Demand and Traffic Patterns

Key Findings

- With the closure of the Battery Street Tunnel northbound on-ramp and southbound off-ramp at Western Avenue, higher ramp volumes in the South Lake Union area are expected, along with lower volumes in the Battery Street Tunnel in both directions. Volumes at the Denny Way ramps are expected to increase slightly under the Build Alternative. These changes in traffic volumes would affect traffic operations, as discussed in Section 5.1.2.

Alaskan Way Viaduct (SR 99) Users

Detailed AM and PM peak-hour traffic estimates for the Year of Opening Baseline Scenario and Build Alternative were developed for SR 99 through the study area. Traffic volumes are presented for each connection to SR 99 (ramps or side streets) and for each mainline segment (section of SR 99 between connections). Traffic volumes are estimated based on current volumes, which were adjusted to reflect growth and traffic redistribution forecasted by the AWW model.

Year of Opening Baseline Mainline and Ramp Volumes – AM Peak Hour

Traffic volumes on the SR 99 corridor are highest during commuting hours. In the morning, peak-hour traffic volumes on SR 99 are directional, with heavier volumes entering the central downtown.

AM peak hour mainline volumes within the study area are higher in the southbound direction, as more vehicles are entering the downtown area (4,300 vehicles) than are leaving it (2,810 vehicles). Southbound off-ramp volumes at Denny Way (1,200 vehicles) exceed those on the northbound on-ramp (400 vehicles). In the Battery Street Tunnel, the volumes are fairly balanced, with the northbound vehicles (3,050 vehicles) slightly exceeding the volume of southbound vehicles (2,810 vehicles). The Battery Street Tunnel ramps providing access to and from the north show directionality as well, with 410 vehicles exiting southbound and only 150 vehicles entering northbound. The ramps to and from the south at Elliott and Western Avenues are expected to have 1,130 vehicles entering southbound and 1,340 vehicles exiting northbound.

Year of Opening Baseline Mainline and Ramp Volumes – PM Peak Hour

Similar to the AM peak, PM peak-hour traffic volumes along SR 99 are directional, with heavier volumes leaving the downtown area (4,480 vehicles) than are entering it (3,530 vehicles). Northbound on-ramp volumes at Denny Way (1,250 vehicles) exceed those on the southbound off-ramp (680 vehicles). In the Battery Street Tunnel, the volume of northbound vehicles (3,410 vehicles) again exceeds the volume of southbound vehicles (2,970 vehicles). The Battery Street Tunnel ramps providing access to and from the north show directionality as well, with 490 vehicles entering northbound but only 200 vehicles exiting southbound. The ramps to and from the south at Elliott and Western Avenues are fairly balanced, with 1,330 vehicles entering southbound and 1,260 vehicles exiting northbound.

The AM and PM peak-hour mainline and ramp volumes forecasted for the Year of Opening Baseline Scenario are shown in Exhibit 5-15.

Year of Opening Build Alternative Mainline and Ramp Volumes – AM and PM Peak Hours

Because the Build Alternative would close the Battery Street Tunnel ramps and therefore does not include a northbound on-ramp or southbound off-ramp at Western Avenue, higher ramp volumes in the South Lake Union area and lower volumes in the Battery Street Tunnel in both directions are expected compared to the Year of Opening Baseline Scenario.

The vehicles that would have used the Battery Street Tunnel ramps are expected to use connections provided in the South Lake Union area instead, particularly the northbound on-ramp and southbound off-ramp at Denny Way, both of which would have increased volumes over the Year of Opening

Baseline Scenario. The northbound off-ramp at Western Avenue and southbound on-ramp at Elliott Avenue are anticipated to have similar volumes to the Year of Opening Baseline Scenario.

The year of opening AM and PM peak-hour mainline ramp volumes forecasted for the Build Alternative are shown in Exhibit 5-16.

Arterial and Local Street Forecasts

AM and PM peak-hour traffic estimates for arterial and local streets for the year of opening were derived from year 2030 estimates. They were adjusted to opening year demand levels by the negative application of growth rates and changes in traffic patterns forecasted by the AWWV model.

5.4.2 Traffic Operations

Key Findings

- The Project would provide a benefit for portions of northbound and southbound SR 99 in the study area by reducing traffic volumes and improving LOS and speeds.
- The Project is not expected to negatively affect LOS conditions at study area intersections during the Year of Opening (2011) AM peak hour. Most intersections are expected to continue to operate at LOS D or better. Intersections already operating below LOS D during the AM peak hour for the Year of Opening Baseline Scenario are not expected to degrade any further with the Year of Opening Build Alternative.
- During the PM peak hour, changes in traffic patterns are expected to worsen congested conditions at some study area intersections.

SR 99 Mainline Level of Service

This section presents the AM and PM peak-hour LOS for corridor segments under the Year of Opening Baseline and Build Alternative. Mainline traffic performance was modeled using VISSIM simulation software. LOS for mainline and ramp operations was calculated based on speed and density, as observed in the VISSIM model. Although LOS can provide an indication of how a facility is performing overall, it is not always a straightforward means of comparing scenarios, because ramp and segment arrangements vary among the scenarios.

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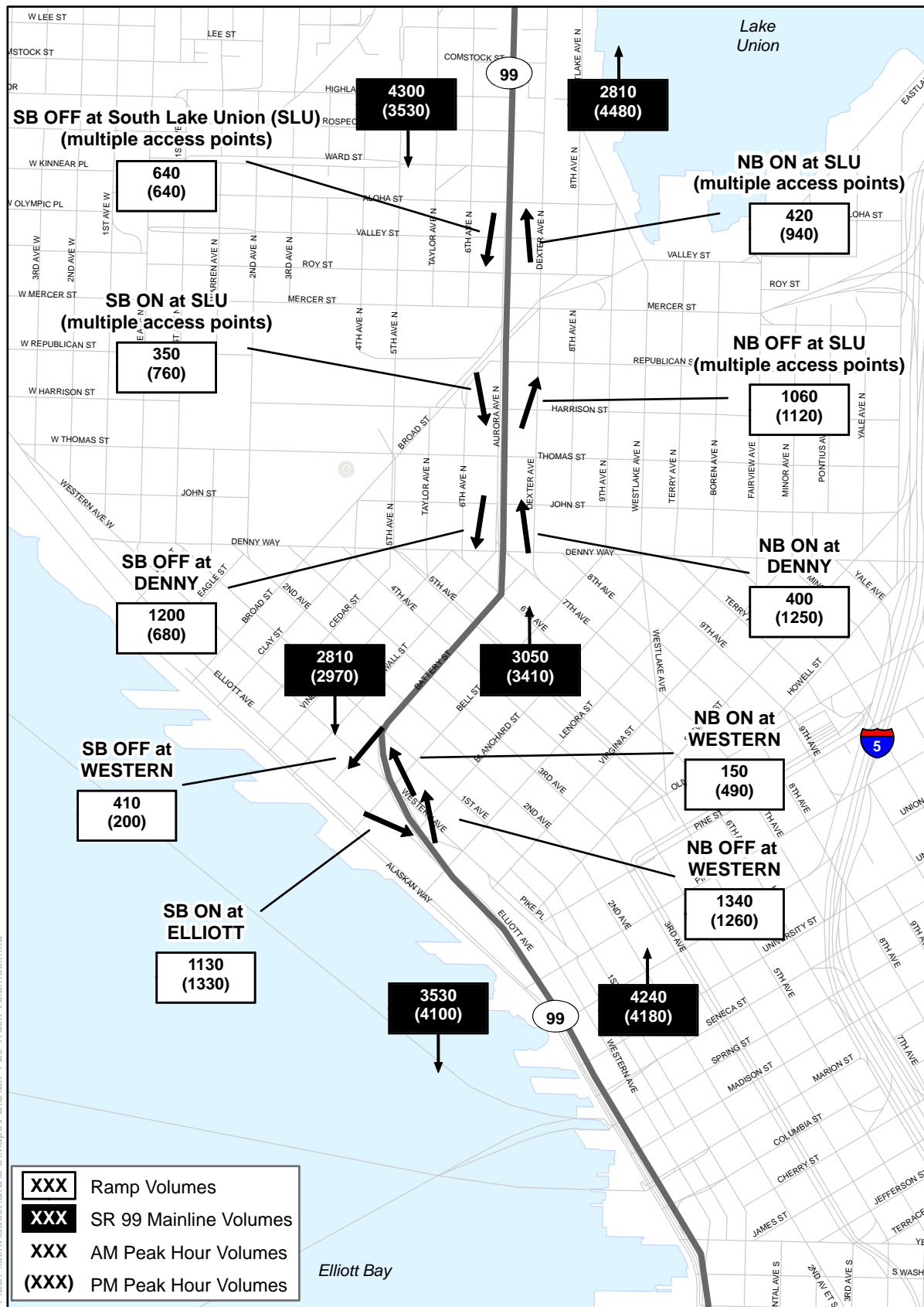


Exhibit 5-15
Year of Opening Baseline
SR 99 Mainline and Ramp Volumes
AM and PM Peak Hour

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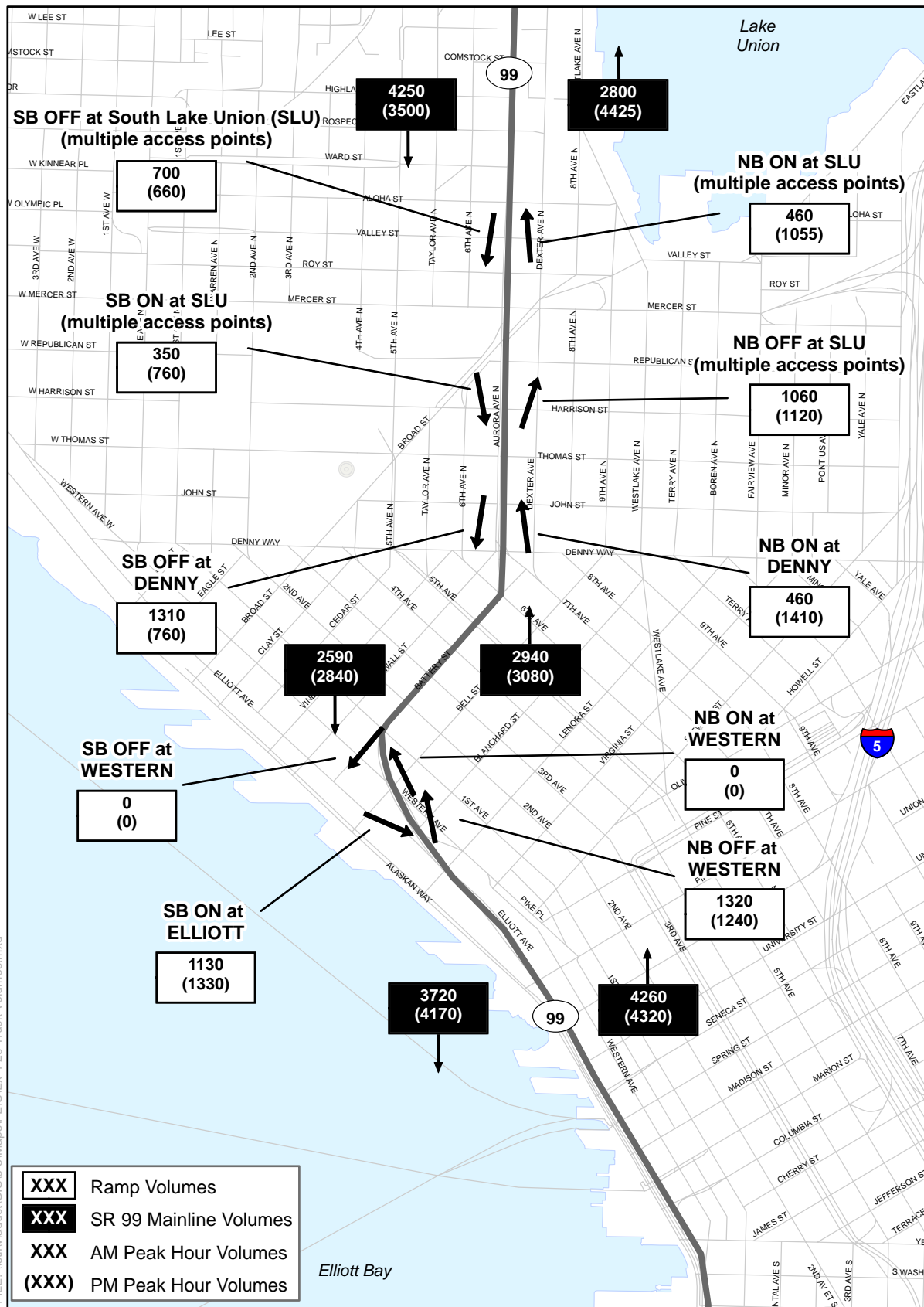


Exhibit 5-16
Year of Opening Build Alternative
SR 99 Mainline and Ramp Volumes
AM and PM Peak Hour

Year of Opening Baseline LOS

Exhibits 5-17 and 5-18 show the SR 99 mainline LOS by segment for the existing facility, for Year of Opening (2011) travel demands during the AM and PM peak hours, respectively. The corridor is expected to operate under LOS E or better with a few exceptions for the Baseline Scenario. During both the AM and PM peak hours in the northbound direction, the segments from the Western Avenue off-ramp through the Battery Street Tunnel are forecasted to operate at LOS F conditions.

Exhibit 5-17. Year of Opening Baseline AM Peak-Hour SR 99 Segment LOS

Southbound		Northbound	
North of Broad Street	E	C	North of Broad Street
Broad Street to Battery Street Tunnel	E	D	Battery Street Tunnel to Broad Street
Battery Street Tunnel	E	F	Battery Street Tunnel
Battery Street Tunnel to Elliott On-ramp	D	F	Western Off-ramp to Battery Street Tunnel
South of Elliott On-ramp	C	E	South of Western Off-ramp

Exhibit 5-18. Year of Opening Baseline PM Peak-Hour SR 99 Segment LOS

Southbound		Northbound	
North of Broad Street	D	E	North of Broad Street
Broad Street to Battery Street Tunnel	D	E	Battery Street Tunnel to Broad Street
Battery Street Tunnel	E	F	Battery Street Tunnel
Battery Street Tunnel to Elliott On-ramp	E	F	Western Off-ramp to Battery Street Tunnel
South of Elliott On-ramp	D	D	South of Western Off-ramp

Build Alternative LOS

The closure of the Battery Street Tunnel ramps is expected to affect traffic operations with the Build Alternative. Exhibits 5-19 and 5-20 show the SR 99 mainline LOS by segment for the Year of Opening Build Alternative.

Exhibit 5-19. Year of Opening Build Alternative AM Peak-Hour SR 99 Segment LOS

Southbound		Northbound	
North of Broad Street	E	C	North of Broad Street
Broad Street to Battery Street Tunnel	F	D	Battery Street Tunnel to Broad Street
Battery Street Tunnel	D	E	Battery Street Tunnel
Battery Street Tunnel to Elliott On-ramp	E	F	Western Off-ramp to Battery Street Tunnel
South of Elliott On-ramp	C	D	South of Western Off-ramp

Exhibit 5-20. Year of Opening Build Alternative PM Peak-Hour SR 99 Segment LOS

Southbound		Northbound	
North of Broad Street	D	E	North of Broad Street
Broad Street to Battery Street Tunnel	D	E	Battery Street Tunnel to Broad Street
Battery Street Tunnel	D	F	Battery Street Tunnel
Battery Street Tunnel to Elliott On-ramp	E	F	Western Off-ramp to Battery Street Tunnel
South of Elliott On-ramp	D	D	South of Western Off-ramp

Changes in LOS are forecasted along several segments under the Build Alternative. LOS in the southbound direction through the Battery Street Tunnel is forecasted to improve from LOS E to LOS D under the Build Alternative. In the northbound direction during the Year of Opening AM peak hour, the segment through the Battery Street Tunnel is forecasted to improve from LOS F to LOS E. The segment south of the Western Avenue off-ramp, in the northbound direction, is forecasted to improve from LOS E to LOS D during the Year of Opening Build Alternative AM peak hour.

LOS is expected to decrease in several segments for the Year of Opening Build Alternative. Operations in the segment between the Battery Street Tunnel and the Elliott Avenue on-ramp, in the southbound direction, are forecasted to degrade from LOS D to LOS E under the Year of Opening Build Alternative during the AM peak hour. Volumes are expected to be higher on this segment due to the closure of the Battery Street Tunnel southbound off-ramp. In addition, conditions in the southbound segment from Broad Street to the Battery Street Tunnel are forecasted to worsen from LOS E to LOS F during the AM peak hour under the Year of Opening Build Alternative. Speeds along this segment are expected to be similar between the Year of Opening Baseline and the Build Alternative. The difference in LOS is likely due to slightly more congestion along that segment for the Build Alternative due to weaving as more vehicles exit north of the Battery Street Tunnel.

During the Year of Opening PM peak hour, mainline traffic operations for the Build Alternative would be comparable to the Year of Opening Baseline Scenario, with one exception. The segment through the Battery Street Tunnel, in the southbound direction, is forecasted to improve from LOS E to LOS D. Traffic volumes are forecasted to decrease through the Battery Street Tunnel (due to the closure of the Battery Street Tunnel ramps) and speeds are expected to increase, causing LOS to improve in the southbound direction.

SR 99 Mainline Speeds

This section presents the AM and PM peak hour travel speeds for corridor segments for the Year of Opening Baseline Scenario and the Build Alternative. Mainline traffic speeds were modeled using VISSIM simulation software.

Travel speed results for the corridor segments confirm the LOS findings for the Year of Opening Baseline Scenario. The results show congested conditions causing slower speeds on the existing facility in the southbound direction and portions of the northbound direction during the AM peak hour (Exhibit 5-21). During the PM peak hour, there would be slow speeds on segments of the northbound direction, with relatively higher speeds on most southbound segments (Exhibit 5-22).

Exhibit 5-21. Year of Opening Baseline AM Peak-Hour SR 99 Segment Speeds

Southbound		Northbound	
North of Broad Street	35	41	North of Broad Street
Broad Street to Battery Street Tunnel	34	40	Battery Street Tunnel to Broad Street
Battery Street Tunnel	28	34	Battery Street Tunnel
Battery Street Tunnel to Elliott On-ramp	37	26	Western Off-ramp to Battery Street Tunnel
South of Elliott On-ramp	48	42	South of Western Off-ramp

Exhibit 5-22. Year of Opening Baseline PM Peak-Hour SR 99 Segment Speeds

Southbound		Northbound	
North of Broad Street	41	36	North of Broad Street
Broad Street to Battery Street Tunnel	42	38	Battery Street Tunnel to Broad Street
Battery Street Tunnel	42	34	Battery Street Tunnel
Battery Street Tunnel to Elliott On-ramp	35	24	Western Off-ramp to Battery Street Tunnel
South of Elliott On-ramp	48	49	South of Western Off-ramp

Under the Year of Opening Build Alternative (Exhibits 5-23 and 5-24), peak period travel speeds are generally expected to be the same as for the Baseline Scenario. However, speeds are expected to increase through the Battery Street Tunnel in the southbound direction during the AM peak hour due to the decrease in volumes on SR 99 as a result of closing the Battery Street Tunnel ramps.

Exhibit 5-23. Year of Opening Build Alternative AM Peak-Hour SR 99 Segment Speeds

Southbound		Northbound	
North of Broad Street	37	40	North of Broad Street
Broad Street to Battery Street Tunnel	33	40	Battery Street Tunnel to Broad Street
Battery Street Tunnel	42	34	Battery Street Tunnel
Battery Street Tunnel to Elliott On-ramp	36	26	Western Off-ramp to Battery Street Tunnel
South of Elliott On-ramp	48	42	South of Western Off-ramp

Exhibit 5-24. Year of Opening Build Alternative PM Peak-Hour SR 99 Segment Speeds

Southbound		Northbound	
North of Broad Street	41	36	North of Broad Street
Broad Street to Battery Street Tunnel	42	37	Battery Street Tunnel to Broad Street
Battery Street Tunnel	42	34	Battery Street Tunnel
Battery Street Tunnel to Elliott On-ramp	35	26	Western Off-ramp to Battery Street Tunnel
South of Elliott On-ramp	48	49	South of Western Off-ramp

Arterial and Local Street Traffic Performance

This section reports the results of the Synchro and SimTraffic analysis for the Year of Opening Build Alternative.

Synchro Observations

For the year of opening, the project team analyzed intersection operations at adjacent and nearby intersections. Traffic operations on other study area streets and highways can be affected by either redistribution effects caused by changes to corridor capacity (as described in the previous section), or by relocation of access points to the SR 99 corridor, which affects how traffic distributes to and from the SR 99 corridor. Because most intersections in the study area are signalized, the analysis in this section focuses solely on signalized intersections. Signalized intersection LOS is shown in Exhibit 5-25, and average vehicle delay is presented in Exhibit 5-26.

During the AM peak hour, all of the study intersections are expected to operate at LOS D or better during the year of opening. LOS D represents traffic operations that are near capacity.

Exhibit 5-25. Signalized Intersection Level of Service

Street	Cross Street	2005 Existing	Year of Opening Baseline	Year of Opening Build	2005 Existing	Year of Opening Baseline	Year of Opening Build
		AM PEAK HOUR			PM PEAK HOUR		
Western Avenue	Wall Street	C	C	C	C	D	D
First Avenue	Wall Street	B	B	B	C	C	C
Second Avenue	Wall Street	B	B	B	B	B	B
Third Avenue	Wall Street	B	B	B	B	C	C
Fourth Avenue	Wall Street	C	C	C	A	A	A
Fourth Avenue	Battery Street	B	C	C	C	C	C
Fourth Avenue	Bell Street	A	A	A	B	B	B
Fourth Avenue	Blanchard Street	A	A	A	B	B	B
Fifth Avenue	Wall Street	A	B	B	B	B	B
Fifth Avenue	Battery Street	B	B	C	C	C	D
Fifth Avenue	Bell Street	B	B	B	B	B	B

**Exhibit 5-25. Signalized Intersection Level of Service
(continued)**

Street	Cross Street	2005 Existing	Year of Opening Baseline	Year of Opening Build	2005 Existing	Year of Opening Baseline	Year of Opening Build
		AM PEAK HOUR			PM PEAK HOUR		
Fifth Avenue	Blanchard Street	A	A	A	B	B	B
Fifth Avenue	Denny Way	C	C	C	B	B	B
Fifth Avenue	Broad Street	D	D	D	C	C	D
Sixth Avenue	Wall Street	A	B	A	A	A	A
Sixth Avenue	Battery Street	B	B	B	C	C	D
Sixth Avenue	Bell Street	B	B	B	B	B	B
Sixth Avenue	Blanchard Street	A	A	A	B	C	C
Sixth Avenue	Denny Way	B	C	C	B	C	C
Seventh Avenue	Bell Street	B	B	B	B	B	B
Seventh Avenue	Blanchard Street	B	B	B	B	B	B
SR 99 SB Off-ramp	Denny Way	B	B	B	B	B	B
SR 99 NB On-ramp	Denny Way	B	B	C	D	D	E
Dexter Avenue	Denny Way	D	D	D	D	E	E

The SR 99 northbound on-ramp/Denny Way and Fifth Avenue/Battery Street intersections are expected to change from LOS B under the Year of Opening Baseline to LOS C under the Year of Opening Build Alternative, because of the Project. However, these intersections are still expected to operate at acceptable LOS during the AM peak hour.

The majority of study intersections are expected to operate at LOS D or better during the PM peak hour. However, the SR 99 northbound on-ramp/Denny Way intersection is expected to degrade from LOS D conditions with the Year of Opening Baseline to LOS E with the Year of Opening Build Alternative. LOS B through LOS D designate intermediate operating conditions, and LOS E denotes congested conditions at the point of maximum service rate.

Traffic that uses the Battery Street Tunnel northbound on-ramp under the Baseline Scenario is expected to reroute through Belltown to use the SR 99 northbound on-ramp at Denny Way once the Project closes the Battery Street Tunnel ramps. The additional volume expected at this intersection with the 2030 Build Alternative is expected to degrade operations to LOS E. However, even with the additional traffic, this intersection is not expected to operate under breakdown conditions (LOS F).

Exhibit 5-26. Signalized Intersection Average Vehicle Delay (seconds)

Street	Cross Street	2005 Existing	Year of Opening Baseline	Year of Opening Build	2005 Existing	Year of Opening Baseline	Year of Opening Build
		AM PEAK HOUR			PM PEAK HOUR		
Western Avenue	Wall Street	21.1	24.8	24.3	29.5	48.3	48.0
First Avenue	Wall Street	18.7	19.6	19.6	22.2	27.7	29.0
Second Avenue	Wall Street	11.9	12.8	12.7	14.9	15.9	16.4
Third Avenue	Wall Street	10.5	10.8	10.6	19.3	20.3	20.7
Fourth Avenue	Wall Street	22.5	23.0	23.0	4.3	4.5	4.9
Fourth Avenue	Battery Street	21.3	22.3	22.2	20.1	21.1	22.4
Fourth Avenue	Bell Street	4.2	4.3	4.2	10.0	10.8	10.7
Fourth Avenue	Blanchard Street	9.2	9.5	9.5	14.5	15.3	15.7
Fifth Avenue	Wall Street	16.6	17.5	18.5	11.4	11.9	11.5
Fifth Avenue	Battery Street	17.9	19.3	20.3	21.0	24.7	36.4
Fifth Avenue	Bell Street	11.3	12.7	12.9	15.7	16.5	16.6
Fifth Avenue	Blanchard Street	6.1	6.8	7.1	11.4	11.7	11.9
Fifth Avenue	Denny Way	24.4	26.2	26.1	17.8	18.9	18.9
Fifth Avenue	Broad Street	49.7	53.6	53.6	34.2	34.8	35.0
Sixth Avenue	Wall Street	9.7	10.0	9.9	5.7	6.2	6.6
Sixth Avenue	Battery Street	15.9	16.1	16.5	25.8	27.9	53.3
Sixth Avenue	Bell Street	16.5	16.6	16.2	14.6	15.8	15.7
Sixth Avenue	Blanchard Street	7.7	7.8	7.7	19.6	20.1	20.9
Sixth Avenue	Denny Way	19.7	21.7	21.6	18.1	20.7	21.2
Seventh Avenue	Bell Street	13.8	14.1	14.1	11.2	12.0	11.5
Seventh Avenue	Blanchard Street	11.4	11.5	11.8	15.6	16.3	16.4
SR 99 SB Off-ramp	Denny Way	15.6	16.3	17.7	13.8	18.8	18.6
SR 99 NB On-ramp	Denny Way	18.8	18.7	20.2	51.4	49.7	72.3
Dexter Avenue	Denny Way	38.2	49.2	51.2	39.9	56.0	58.5

Chapter 6 TRANSPORTATION CONDITIONS DURING CONSTRUCTION

6.1 Construction Approach

Construction of the Project is expected to occur over a duration of approximately 24 months. Construction is planned to begin in fall 2009 and end by late spring 2011 and would comprise three stages of traffic revisions.

6.1.1 Traffic Stage 1

Traffic Stage 1 would occur at the immediate start of the Project and last approximately 3 months. Mobilization would occur during this stage, along with closure of the Battery Street Tunnel ramps. The ramp closures would remain permanent, although the ramps would be retained for maintenance and emergency vehicles.

6.1.2 Traffic Stage 2

Over the approximately 15-month duration of Traffic Stage 2, Battery Street Tunnel mechanical, electrical, and civil upgrades and the construction of emergency egress would occur.

Traffic Stage 2 Traffic Revisions – SR 99

SR 99 through the Battery Street Tunnel is anticipated to be closed during weekday evenings and on some weekends. Battery Street Tunnel closures would be on Sunday evenings through Thursday evenings, from 8 p.m. to 6 a.m. The Thursday closure would end at 6 a.m. on Friday. Additionally, the Battery Street Tunnel could be closed to traffic for up to two weekends per month.

Traffic Stage 2 Traffic Revisions – Surface Streets

There would be occasional weekday evening and possibly some weekend closures of Battery Street when work on the tunnel is performed from above (street level). Battery Street surface work would take only a lane or two and would not close the street. The work is expected to be accommodated by partially closing Battery Street and restricting parking to allow traffic to continue to use Battery Street. Some of the surface work may take place during the day but would not affect SR 99 traffic.

Blanchard Street between Elliott and Western Avenues would be closed during construction. This is a short (approximately 100 feet long) one-way segment of Blanchard Street that is lightly used. Closure of this street segment would prevent southbound traffic on Elliott Avenue from turning

left onto Blanchard Street. However, given its limited use and other available routes, such as proceeding one more block and turning left on Lenora Street, closure of this street segment during construction is expected to have minimal effect on mobility.

When the Battery Street Tunnel is closed, signage would indicate detour routes using surface streets. The signs would direct northbound SR 99 traffic to exit at the Western Avenue off-ramp, follow Western Avenue northward for six blocks, turn right onto Broad Street and proceed for two blocks, turn right onto Second Avenue, turn left onto Battery Street, and reenter SR 99 using the Denny Way on-ramp. Southbound SR 99 traffic would exit SR 99 at the Denny Way off-ramp, proceed for about eight blocks on Wall Street, then turn left onto Elliott Avenue, accessing southbound SR 99 using the Elliott Avenue on-ramp.

6.1.3 Traffic Stage 3

Construction activities planned during Traffic Stage 3, which would occur over approximately 6 months, mainly consist of painting, systems testing, and project closeout. Painting would include the reflective paint on the walls, fire zone designation numbers, and red around the phones, exits, and fire cabinets.

Traffic Stage 3 Traffic Revisions – SR 99

Occasional weeknight or weekend closures of the Battery Street Tunnel may be necessary.

Traffic Stage 3 Traffic Revisions – Surface Streets

When the Battery Street Tunnel is closed, detours would be signed as described for Traffic Stage 2.

6.2 Transportation Disruptions During Construction

This section describes expected transportation conditions during the construction period. Given the dynamic nature of construction activities, transportation effects would vary throughout the construction period. Generally, the most severe travel effects would occur during Traffic Stage 2, when SR 99 is anticipated to be closed during weeknights and some weekends and when Battery Street would experience occasional lane restrictions.

6.2.1 Mobility

Traffic diversions and potential trip redistribution due to periodic closures of the Battery Street Tunnel were investigated qualitatively as part of the overall traffic operations analysis. As described previously, the critical detour scenario would likely be represented by Traffic Stage 2, reflecting the anticipated evening/weekend closures and the implementation of suitable

detour strategies. Weeknight closures would start at 8 p.m., and the Battery Street Tunnel would reopen by 6 a.m. on Sundays through Thursdays. Up to two weekend closures may occur each month, which would span from Friday evening (8 p.m.) to Monday morning (6 a.m.). In addition, a brief discussion of potential short-term mobility impacts on SR 99 traffic due to sign bridge installation is provided in this section.

Traffic modeling forecasts were not explicitly developed for this construction scenario assessment, and no level-of-service traffic analysis was conducted to evaluate intersection-level congestion impacts. However, based on 24-hour traffic counts along SR 99 and previous work performed for the Lenora-to-Battery Street Tunnel construction detour analysis, a subjective review of potential diversion routes and traffic volume shifts is provided.

Travel Demand and Traffic Patterns

SR 99 Traffic Affected

Due to closure of the Battery Street Tunnel during evening and weekend periods, SR 99 users are expected to make other travel choices. These choices would likely include switching to other routes, making fewer trips, choosing other destinations, changing travel times, or, to a lesser degree, changing travel modes. For those users that choose alternative routes to the Battery Street Tunnel, the primary diversion routes would generally consist of local surface arterials near or parallel to the Battery Street Tunnel (with the majority using the signed detour routes) and other combinations of freeway/highway facilities such as the Spokane Street Viaduct, SR 519, and I-5.

The potential magnitude of traffic affected by the Battery Street Tunnel closures can be assessed by 24-hour directional counts of SR 99 just north of the Western Avenue/Elliott Avenue ramps (south end of the Battery Street Tunnel). Based on these existing counts of SR 99 mainline traffic, volume profiles and total potential diversion traffic levels were estimated. Exhibit 6-1 summarizes existing average total traffic volumes (by direction) from 8 p.m. to 6 a.m. on weekdays (Monday through Thursday). Also given are total average weekend traffic volumes from Friday evenings to Monday mornings. As shown in this exhibit, average traffic volumes on SR 99 that would be potentially affected during typical evening conditions (weekdays) would amount to approximately 7,000 to 8,000 total vehicles. For the full weekend closures, that number would rise to a range of 40,000 to 50,000 total vehicles. Compared to average weekday daily two-way traffic through the Battery Street Tunnel of approximately 63,400 vehicles (shown in Exhibits 4-8 and 4-9), the evening traffic volumes represented in Exhibit 6-1 are a relatively small component of the overall traffic demand.

Exhibit 6-1. Existing SR 99 Volumes During Evening/Weekend Periods at the South End of the Battery Street Tunnel

Direction	Average Weekday ¹	Average Weekend ²	Average Combined Evening/Weekend Traffic ³
Northbound in BST	4,080	40,500	56,820
Southbound in BST	3,640	45,200	59,760
Total Both Directions	7, 720	85,700	116,580

Notes:

¹ Reflects 10-hour evening closures Sunday to Thursday from 8 p.m. to 6 a.m.

² Reflects full weekend closure from Friday 8 p.m. to Monday 6 a.m.

³ Combination of weekday evening traffic (8 p.m. to 6 a.m.) and weekend traffic.

Detour Routes – Traffic Redistribution

Traffic on the SR 99 corridor during weeknight and weekend closures of the Battery Street Tunnel would be redirected to various detour routes to serve northbound and southbound through trips. Based on a prior detour traffic analysis conducted for the previously proposed Lenora-to-Battery Street Tunnel project work, these detour routes would likely rely on existing SR 99 on- and off-ramps located north and south of the Battery Street Tunnel as well as a series of connecting arterials within the city street network. Key detour routes for both directions are highlighted in Exhibit 6-2. Drivers may select alternatives to the primary detour routes. Likely alternate routes have been shown by the dashed lines in Exhibit 6-2.

In the northbound direction, traffic could follow two key detour routes: one via the Seneca Street off-ramp and the other using the Western Avenue off-ramp. Trips diverting off SR 99 to the Seneca Street off-ramp would likely reconnect to northbound SR 99 using one or more north-south arterials such as First, Third, Fourth, or Sixth Avenues and an east-west arterial such as Battery Street or Blanchard Street. Detours would occur during weekday evenings and some weekends, which are times that Third Avenue is open to general-purpose traffic. Detoured through traffic using the Western Avenue off-ramp would likely use Broad Street and either a combination of Ninth Avenue (southbound), Mercer Street (westbound contraflow lane), Dexter Avenue, and Roy or Aloha Streets; or Broad Street to Second Avenue to Battery Street to SR 99 at the Denny Way on-ramp.

For the southbound direction, the primary detour routes for “through” traffic would be either the Denny Way off-ramp or potentially the upstream off-ramp to Broad Street. Trips diverting to the Denny Way off-ramp would likely use either Wall Street to connect to the Elliott Avenue on-ramp or use downtown arterials such as Second, Third, or Fifth Avenues as a substitute to SR 99. Those southbound vehicles diverting off SR 99 upstream at Broad



Basemap Data Source: City of Seattle, 2007

Street may also choose to use downtown arterials instead of SR 99. However, the majority of these trips are expected to reconnect to southbound SR 99 using Broad Street, Elliott Avenue, and the Elliott Avenue on-ramp.

Traffic Operations

Traffic operations for the anticipated Battery Street Tunnel construction closure periods (weeknights and some weekends) were not explicitly assessed through microscopic analysis or related technical evaluation. As such, SR 99 mainline operations during Battery Street Tunnel closures are qualitatively assessed and summarized in this section based on potential traffic flow conditions near exit points for the detour routes. Arterial operations are similarly assessed with a focus on the magnitude of traffic diverting to potential detours, route choice, and potential hotspot locations within the larger downtown network. Temporary traffic disruptions due to sign bridge installation (north and south of the Battery Street Tunnel) are also discussed.

SR 99 Mainline

As discussed previously, periodic closures could result in the diversion and redistribution of up to nearly 8,000 vehicles over the typical 10-hour evening periods and roughly 86,000 vehicles during weekends. These trips would likely be directed to the detour routes identified in earlier sections. For the northbound direction, detour traffic would primarily use the Seneca Street and Western Avenue off-ramps and then use surface streets to reconnect to, and continue along, SR 99 north of Denny Way. Based on SR 99 traffic counts during the evening closure hours (8 p.m. to 6 a.m.), potential volumes diverting to Seneca Street and Western Avenue would be minor relative to the capacity available at the off-ramps. Signal timing adjustments for the ramp termini intersections would help mitigate the effects of the additional volumes by adding lane capacity to accommodate detour traffic on these ramps. Signal timing changes would only be implemented during the evening and weekend hours of the Battery Street Tunnel closures. For evenings, the changes would result in negligible delay impacts due to the low levels of traffic after 8 p.m. While weekend impacts may be greater, refinements to balance movement delays would be pursued.

Similar evening-related detour effects would occur for the southbound direction based on volume counts along SR 99. The combination of the Broad Street and Denny Way off-ramps for detour routing would not likely result in substantial congestion impacts. Signal timing improvements and potential channelization revisions to better facilitate ramp traffic are mitigation measures that are likely to be sufficient to handle the additional ramp traffic created by Battery Street Tunnel closures.

Weekend traffic congestion at the various ramp exit points for both the northbound and southbound detour routes would be more pronounced than during the evening-based closures. This is due not only to the longer duration of the Battery Street Tunnel closure (Friday evening to Monday morning) but the peaks in traffic that frequently occur during typical Saturdays and Sundays compared to the less traveled weekday evening hours. Provisions to modify signal timings at key detour route intersections and opportunities to rechannelize certain arterials to add detour capacity are recommended as mitigation to best accommodate increases in traffic volumes and associated congestion along key arterials. Refer to Section 6.3.2 for more information on mitigation measures and to Section 6.3.3 for potential mitigation measures to address SR 99 traffic during events.

Temporary evening disruptions to mainline SR 99 traffic due to overhead sign bridge construction and installation have been identified by the project team as minor events associated with the larger Battery Street Tunnel construction/closure effort. The existing sign bridges on SR 99 at approximately Virginia Street and at Thomas Street would be demolished and reconstructed. An additional new sign would be installed on SR 99 at approximately Ward Street. As currently proposed, the sign bridge work would occur under evening temporary lane closures. For the northbound direction, potential lane closures would not reduce overall SR 99 northbound capacity since only one lane of capacity is provided to the Western Avenue off-ramp under typical Battery Street Tunnel closures. However, the northbound lane closures would begin farther south than during normal construction periods and may result in greater diversion to the Seneca Street off-ramp and use of downtown streets. Nonetheless, congestion impacts to mainline SR 99 traffic, the Seneca Street off-ramp, and affected downtown intersections would likely be minor as the sign bridge work would occur during the low-demand evening periods and would last less than 2 weeks.

The southbound lane closures near Ward and Thomas Streets may involve only one lane of traffic and would similarly occur only during evening periods for up to 2 weeks. As such, southbound impacts to SR 99 traffic flow and associated detour activity would be modest.

While the old signs are removed and the new signs are installed over the roadway, all lanes under the signs would need to be closed. These closures are expected to take up to three nights per sign.

Arterial Traffic Performance

The potential detour routes within the downtown street network, as described previously, would be relied on as the primary means of accommodating northbound and southbound through traffic on SR 99 during closure periods.

For the northbound construction detours, key north-south arterials that may be affected include First, Third, Fourth, and Sixth Avenues. In addition, east-west arterials such as Battery Street and Blanchard Street may also be affected in terms of heavier traffic demands and congestion levels compared to pre-closure conditions. Key arterials affected by southbound detours would include Broad Street, Wall Street, and various north-south arterials through downtown such as Second, Third, Fifth, and Seventh Avenues. Intersection hotspots that may need to be considered for potential temporary construction traffic mitigation measures are listed in Exhibit 6-3.

Exhibit 6-3. Potential Detour Hotspot Locations

Intersection	Northbound Detours	Southbound Detours
First Avenue & Seneca Street	X	
Third Avenue & Seneca Street	X	
Third Avenue & Blanchard	X	
SR 99 NB On-ramp & Denny Way	X	
Ninth Avenue N & Mercer Street	X	
Western Avenue & Battery Street	X	
Western Avenue & Wall Street	X	X
Western Avenue & Broad Street	X	X
Denny Way & Broad Street	X	X
Fifth Avenue N & Broad Street		X
Elliott Avenue & Wall Street		X
Elliott Avenue & Broad Street		X
SR 99 SB Off-ramp & Denny Way		X

Traffic Disruptions on Battery Street (Surface Arterial)

Due to construction activity related to the tunnel ventilation system during Battery Street Tunnel closures, grate removal along Battery Street (surface arterial) would be required periodically. As such, traffic disruptions on Battery Street may occur concurrently with Battery Street Tunnel closure detours in place. Battery Street surface work would take only one or two lanes and would not close the street. To maintain suitable levels of capacity on Battery Street and minimize traffic congestion impacts on the surface street network during these worst-case scenario conditions, mitigation measures related to signal timing enhancements and parking restrictions would be needed to ensure that detour traffic is reasonably accommodated, especially for northbound detours during weekend closures. Comparatively, evening closures would not require as extensive measures to mitigate congestion impacts due to the lower traffic volumes diverted away from SR 99 and onto local downtown arterials.

6.2.2 Accessibility

Construction activities would result in disruptions to SR 99 and surface street traffic. This section considers how automobile, transit, freight, bicycle, and pedestrian access would be affected during the construction period.

Roadway Connectivity and Access

SR 99

At the start of construction, the Battery Street Tunnel ramps would be closed. This closure would be permanent.

Access to the northbound off-ramp to Western Avenue and southbound on-ramp from Elliott Avenue would be maintained throughout construction. Similarly, the Denny Way ramps would be open throughout construction.

During Traffic Stage 2, SR 99 would be closed through the Battery Street Tunnel during weekday evenings and some weekends. Detour routes would be signed, and some drivers are expected to choose unsigned alternate routes. The detour routes are more circuitous than the existing route that SR 99 takes through the Battery Street Tunnel.

Local Street Access

Some of the work would take place on the surface of Battery Street. These construction activities would result in disruptions to Battery Street during Traffic Stage 2. There would likely be some daytime, evening, and weekend partial closures of Battery Street. However, through the restriction of parking during these times, traffic would be maintained on and across Battery Street. Construction would briefly affect the intersection of Battery Street and Sixth Avenue. Other cross-street intersections with Battery Street would not be affected. Additionally, Wall Street and Battery Street would experience detour traffic during SR 99 closures.

Local access to businesses within the project area would be maintained throughout the construction period. In addition, particular care will need to be taken to ensure that potential disruptions to Fire Station No. 2, located on the corner of Fourth Avenue and Battery Street, are avoided or minimized to the extent practicable.

Transit Connectivity and Coverage

King County Metro bus services using SR 99 would not be directly affected by evening and weekend closures of SR 99 during the construction period because Metro bus routes do not use the Battery Street Tunnel. In addition, a good share of the transit service on SR 99 is express service, which generally does not operate during the evening and weekend construction closure period. However, buses may experience more congestion on the Denny Way ramps and on streets

in Belltown when the Battery Street Tunnel is closed. Buses traveling through Belltown also may experience more congestion when the Battery Street Tunnel is closed due to traffic detouring around the tunnel. Partial Battery Street closures would probably not necessitate bus detours, but could mean that buses would need to travel more slowly through the construction zone. Currently, 33 bus routes either travel on or cross Battery Street.

To help minimize disruptions to bus service, WSDOT will coordinate with Metro Transit in advance of work on Battery Street that would affect buses. In particular, Metro's trolley (electric bus) routes would have the most difficulty with route deviations. Several trolley routes use Third Avenue and cross Battery Street. Sufficient advance coordination would be undertaken to allow Metro Transit to plan to run diesel coaches on the affected routes in the event that there would be deviations in the trolley routes.

Freight Access

Freight access is a key concern given the importance of SR 99, Western Avenue, and Elliott Avenue as freight routes.

SR 99 would be closed through the Battery Street Tunnel during evenings and weekends during Traffic Stage 2 and possibly during occasional evenings and weekends during Traffic Stage 3. As described in Chapter 4, truck volumes peak during the midday and afternoon on weekdays, and are relatively low at all other times. Closure of the Battery Street Tunnel during evenings and on some weekends should help minimize the effect of the closure on trucks. However, trucks using SR 99 during the evening and weekend closure periods would need to detour to other routes. The Downtown Traffic Control Zone restrictions (described in Section 4.2.6) apply to trucks over 30 feet long and are in effect Monday through Saturday between the hours of 6:00 a.m. and 7:00 p.m. These restrictions would overlap with Saturday closures of SR 99. In those instances, alternative routes and appropriate signing should be provided to avoid having trucks over 30 feet long enter the zone without the necessary permits.

Large trucks would likely avoid the signed detours to Wall Street and Battery Street and instead use Major Truck Streets such as Western Avenue, Elliott Avenue, Broad Street, and Denny Way. Western and Elliott Avenues would remain open throughout the construction period, maintaining a vital freight link.

Pedestrian and Bicycle Access

With the closure of the Battery Street Tunnel ramps during Traffic Stage 1, crossing the street at the ramp termini locations would become easier.

Pedestrians and bicyclists would experience minor disruptions during construction. At times, the sidewalk on one side or the other of Battery Street, between First and Sixth Avenues, would be closed. One-half to one block of sidewalk would be closed at a time, for less than 1 week. This would occur twice, on nonconsecutive weeks, so a given sidewalk could be closed for up to a total of about 2 weeks. The sidewalk on the other side of the street would be open and would provide a detour route. Access to businesses will be maintained at all times.

There may also be sidewalk closures that last less than 2 weeks that affect segments of sidewalk (less than one-half block in length) on First through Sixth Avenues close to the intersections with Battery Street. Pedestrian detour routes would be provided. All pedestrian detour routes would be Americans with Disabilities Act (ADA) accessible.

The sign bridge work on SR 99 at Thomas and Ward Streets also may result in sidewalk closures for up to 2 weeks on the west side of Aurora Avenue.

During Traffic Stage 2, some of the traffic detouring off of SR 99 would use surface streets. Increased traffic could make it more difficult for pedestrians and bicycles to cross the street. Pedestrian crossings of the SR 99 northbound off-ramp to Western Avenue and the southbound on-ramp from Elliott Avenue likely would become more difficult with the closure of the Battery Street Tunnel. Neither of these intersections is signalized. Mitigation such as increased signage and warning lights may be considered to improve pedestrian safety. Bicyclists riding in the street may face increased potential for conflicts with vehicles given the higher volume of traffic and drivers that may be unfamiliar with detour routes. Accommodations would be made for pedestrian and bicycle access around closed portions of Battery Street (surface street).

During Traffic Stage 3, there would be occasional closures of the Battery Street Tunnel, at which time the conditions for pedestrians and bicyclists would be similar to Traffic Stage 2 conditions.

Parking Effects

Parking restrictions may be necessary along Battery Street because some construction work would take place on the surface above the tunnel. Battery Street surface work would take one or two lanes and would not close the street. Restrictions lasting less than 2 weeks may also affect a few parking spaces on First through Sixth Avenues near the intersections with Battery Street. The sign bridge work on Aurora Avenue may result in a few parking spaces being restricted for several weeks on Thomas and Ward Streets.

In addition, the primary streets onto which SR 99 traffic is being detoured (Wall Street between Denny Way and Elliott Avenue and Battery Street between Sixth Avenue and Second Avenue) may experience parking restrictions when the detours are in effect on weeknight evenings and some weekends. Each of these streets currently accommodates metered parking on both sides of the street.

The Project's staging areas would affect several parking lots. Exhibit 6-4 shows the locations of the potential parking removals. For the duration of construction, parking would be affected in the following locations:

- Six (6) on-street parking spaces would be removed on Blanchard Street between Elliott and Western Avenues.
- Seventy-five (75) off-street spaces in a pay lot under the viaduct between Bell and Blanchard Streets would be removed. These spaces are currently available only to monthly permit parkers.
- Approximately 12 spaces would be permanently removed in a private parking lot on the northeast corner of Battery Street and Third Avenue. These spaces are currently private parking spaces and are not available to the public.

After construction is complete, the affected on-street parking and most of the off-street parking would be replaced or restored. Approximately 12 off-street spaces in the private parking lot on the northeast corner of Battery Street and Third Avenue would not be replaced.

For the duration of project construction, the estimated workforce would involve up to about 50 construction workers. The contractor may provide parking within or near the staging areas, or could pursue an option such as operating a shuttle to a more remote parking lot. If construction workers do not have designated parking areas, they would likely seek available long-term parking in the areas near the tunnel portals, first pursuing on-street spaces and then pay lots. However, the use of any on-street parking spaces by construction workers would have to be coordinated and approved by the City. It is anticipated that the City would discourage the use of on-street parking spaces by construction workers. On-street parking spaces are free after 6:00 p.m. and on Sundays.

Approximately 2,100 off-street parking spaces (i.e., parking garages and lots) are located within several blocks of Battery Street, as calculated from PSRC parking trends (PSRC 2006).

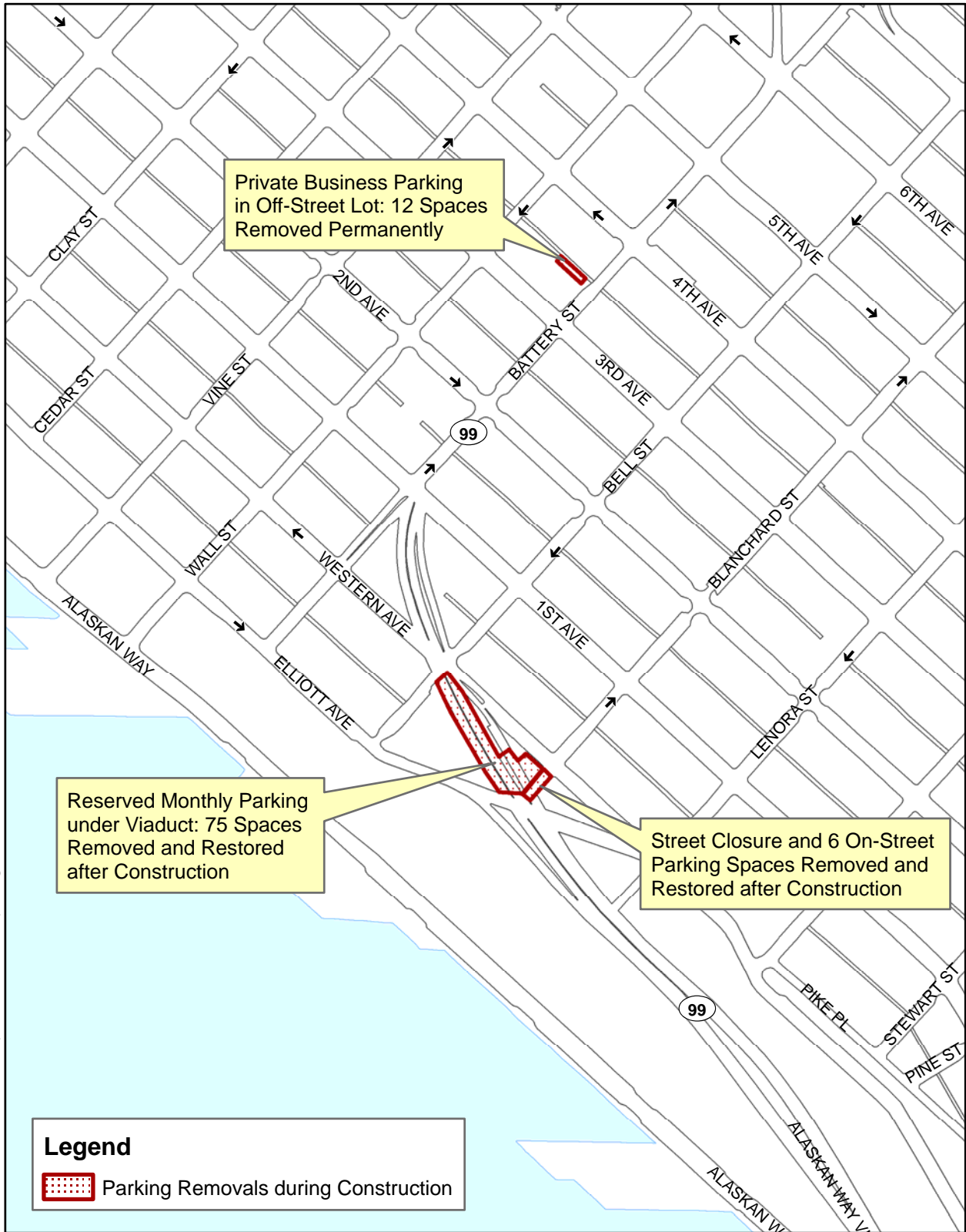


Exhibit 6-4
Potential Parking Removals
During Construction

6.2.3 Safety

The overall purpose of the Project is to provide safety improvements to the Battery Street Tunnel. Closure of the Battery Street Tunnel ramps would have an immediate safety benefit.

As safety improvements are made during Traffic Stage 2, such as addition of edge-line pavement markings, drivers using the Battery Street Tunnel after it reopens each day would benefit.

During Traffic Stage 2, increased traffic on surface streets through Belltown could make it more difficult for pedestrians and bicyclists to cross the street. ADA-accessible detour routes, appropriate signing, and barricades would be put into place. Additionally, bicyclists riding in the street may face increased potential for conflicts with vehicles.

6.3 Mitigation

6.3.1 SR 99/Viaduct Project Initial Transit Enhancements and Other Improvements

Goals

The goal of the SR 99/Viaduct Project Initial Transit Enhancements and Other Improvements is to provide investment funding to develop and deliver projects and strategies within areas potentially affected by construction of the Moving Forward projects. These enhancements and improvements are independent projects that benefit all pending improvements under the AWVSRP. As such, they are not part of the SR 99: Battery Street Tunnel Fire and Safety Improvements Project and will each be evaluated separately.

The SR 99/Viaduct Project Initial Transit Enhancements and Other Improvements will help maintain overall travel mobility and keep the system moving during construction of the Moving Forward projects. Up to \$125 million has been set aside for funding the SR 99/Viaduct Project Initial Transit Enhancements and Other Improvements. These projects and strategies include additional transit service hours and facilities to monitor transit reliability, traveler information systems, improvements to arterial and street traffic operations, and to support transportation demand management efforts and other projects.

Enhancements and Mitigation Advisory Team

A multi-agency team was formed to oversee the development of the SR 99/Viaduct Project Initial Transit Enhancements and Other Improvements projects. This team, called the Enhancements and Mitigation Advisory Team (EMAT), has recommended a list of projects for implementation.

Downtown Transportation Operations Committee

WSDOT, the City of Seattle, and King County have identified the need for ongoing coordination of the various construction activities. A new committee, the Downtown Transportation Operations Committee, may be created to support construction activities in the greater downtown Seattle area. It would likely be charged with the monitoring and coordination of transportation construction activities, as well as multimodal operational responses to address the effects of that construction.

This Downtown Transportation Operations Committee would lead the coordination efforts to ensure multimodal transportation operations are as effective as possible during downtown project construction activities. This committee would provide for real-time communications and information linkages to better manage the multimodal transportation network.

Initial Transit Enhancements and Other Improvements candidate projects have been identified for initial funding and implementation. These projects require some development lead time to be operational by the time SR 99 traffic revisions begin. Exhibit 6-5 lists the projects, which are described in more detail following the table. The approximate locations of potential improvements are shown in Exhibit 6-6.

Exhibit 6-5. Summary of SR 99/Viaduct Project Initial Transit Enhancements and Other Improvements

No.	Project Name	Travel Market	Functional Goals
1	SR 519 Intermodal Access Project, Phase 2	<ul style="list-style-type: none">• Freight to/from Port• SODO	<ul style="list-style-type: none">• Highway and street system reliability• Freight connectivity
2	Spokane Street Viaduct Widening Project	<ul style="list-style-type: none">• West Seattle• SODO• Duwamish	<ul style="list-style-type: none">• Highway and street system reliability• Freight connectivity• Traffic redistribution
3	Elliott Avenue W./ 15th Avenue W. Corridor Improvements (ITS and transit support)	<ul style="list-style-type: none">• Ballard• Magnolia/Interbay	<ul style="list-style-type: none">• Highway and street system reliability• Traveler information• ITS infrastructure to support transit signal priority and real-time transit information
4	West Seattle Corridor Improvements (ITS and transit support)	<ul style="list-style-type: none">• West Seattle	<ul style="list-style-type: none">• Highway and street system reliability• Traveler information• ITS infrastructure to support transit signal priority and real-time transit information

Exhibit 6-5. Summary of SR 99/Viaduct Project Initial Transit Enhancements and Other Improvements (continued)

No.	Project Name	Travel Market	Functional Goals
5	SODO/Integrated Corridor Management Improvements (ITS and transit support)	<ul style="list-style-type: none"> • SODO • Georgetown • I-5 	<ul style="list-style-type: none"> • Highway and street system reliability • Traveler information • ITS infrastructure to support transit signal priority and real-time transit information
6	I-5 Travel Time Signs	<ul style="list-style-type: none"> • Regional through trips on I-5 	<ul style="list-style-type: none"> • Traveler information
7	Secure Use of New Buses and Transit Service Hours	<ul style="list-style-type: none"> • West Seattle • Burien • White Center • Ballard • Aurora • I-5 Corridor 	<ul style="list-style-type: none"> • Increased transit capacity • Increased transit frequency • Increased transit system reliability
8	Bus Travel Time Monitoring System	<ul style="list-style-type: none"> • Transit system 	<ul style="list-style-type: none"> • Transit system reliability
9	I-5 Active Traffic Management	<ul style="list-style-type: none"> • I-5 Corridor 	<ul style="list-style-type: none"> • Freeway system reliability • Incident reduction • Incident severity reduction
10	Ballard and SODO Arterial Travel Time System	<ul style="list-style-type: none"> • Ballard/Magnolia/Interbay • SODO 	<ul style="list-style-type: none"> • Traveler information • Street system reliability
11	Denny Way Corridor Improvements (ITS)	<ul style="list-style-type: none"> • Ballard/South Lake Union/Queen Anne 	<ul style="list-style-type: none"> • Street system reliability • Traveler information
12	South End Transportation Demand Management (TDM)	<ul style="list-style-type: none"> • West Seattle • South Seattle • Burien • Tukwila 	<ul style="list-style-type: none"> • Traveler information • SOV trip reduction
13	Downtown Transportation Demand Management	<ul style="list-style-type: none"> • Downtown Seattle retail/commercial 	<ul style="list-style-type: none"> • Traveler information • SOV trip reduction • Parking management
14	In-Construction Adaptation Project	<ul style="list-style-type: none"> • All 	<ul style="list-style-type: none"> • System modifications to adapt program to ongoing construction activities (project flexibility)

SODO = South of Downtown

SOV = single-occupancy vehicle

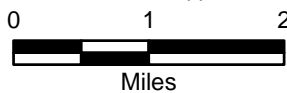
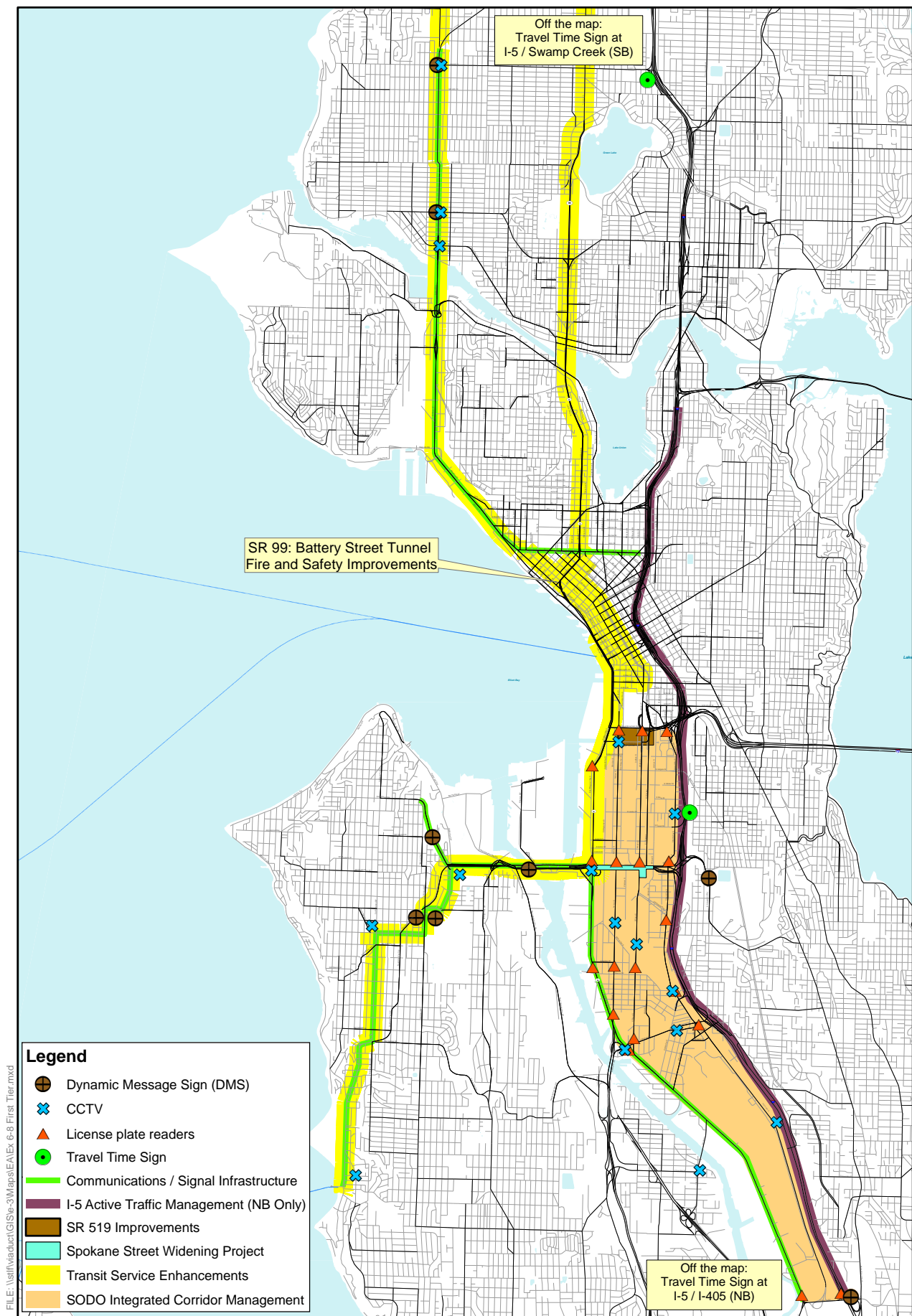


Exhibit 6-6
Potential Locations of SR 99/Viaduct
Project Initial Transit Enhancements
and Other Improvements

SR 519 Intermodal Access Project, Phase 2

This project will receive partial funding from the AWVSRP. The project design calls for constructing a new westbound off-ramp from I-5 and I-90 via the current S. Atlantic Street overpass. Surface street improvements will be made at the First Avenue S./S. Atlantic Street and Occidental Avenue S./S. Atlantic Street intersections. The project design also calls for a grade-separated crossing at S. Royal Brougham Way, which will eliminate vehicle, freight, and pedestrian conflicts with trains at S. Royal Brougham Way and Third Avenue S.

Spokane Street Viaduct Widening Project

The AWVSRP would provide partial funding to complete design and construction of a widened Spokane Street Viaduct between SR 99 and I-5, as well as an eastbound off-ramp from the Spokane Street Viaduct to Fourth Avenue S.

The project will enhance highway and street system reliability by providing more opportunities for traffic to redistribute itself on more travel corridors, improving connections and access for West Seattle trips to downtown.

Elliott Avenue W./15th Avenue W. Corridor Improvements (ITS and Transit Support)

This project will implement dynamic message signs (DMS), closed-circuit television (CCTV), and traffic signal upgrades in the Elliott Avenue W./15th Avenue W. corridor (from Denny Way to N. 85th Street). The project will also provide the communications and traffic signal infrastructure needed to support transit signal priority for future Ballard-to-downtown RapidRide service. The project will include installing fiber-optic cable and traffic signal upgrades to facilitate transit signal priority functionality.

This project will provide real-time traveler information to help divert traffic off the SR 99 corridor during major construction and improve transportation system operations. It will also provide improvements to the traffic signal system in key corridors, which will help improve transit speeds and schedule reliability, especially for new RapidRide services and general-purpose traffic operations on affected city streets.

West Seattle Corridor Improvements (ITS and Transit Support)

This project will implement DMS along three West Seattle corridors and improve communications capabilities by extending fiber-optic cable across the West Seattle Bridge. It will provide the communications and traffic signal infrastructure needed to support transit signal priority for the West Seattle-to-downtown RapidRide service.

The project will provide real-time traveler information to help divert traffic off the SR 99 corridor during major construction and improve transportation system operations. This will help improve highway and street system reliability. The project will also help facilitate the swift and reliable movement of future RapidRide buses, which will help encourage mode shift and reduce auto demand in the West Seattle-to-downtown travel corridor.

SODO/Integrated Corridor Management Improvements (ITS and Transit Support)

These improvements involve implementing DMS, CCTV, a Highway Advisory Radio system, and traffic signal controller and communications upgrades on major arterials in the SODO/Duwamish Valley area. Center-to-center communications software development and integration of ramp terminal signals will also be included. License plate reader technology will be provided to gather arterial street travel time data on First Avenue S., Airport Way S., and Fourth Avenue S. from the Boeing Access Road to S. Royal Brougham Way (SR 519).

This project will provide real-time traveler information to help divert traffic off the SR 99 corridor during major construction and improve transportation system operations. It will also provide improvements to the traffic signal system in key corridors to help improve transit speeds, schedule reliability, and general-purpose traffic operations on affected city streets.

I-5 Travel Time Signs

The I-5 Travel Time Signs project involves static message signs that provide real-time travel time information. Signs will be placed at key decision points on I-5. These locations could include south of the I-405 interchanges at Tukwila and approaching the I-5/I-90 interchange area for southbound traffic, and the I-5/Northgate area and north of the I-405 interchange at Swamp Creek for southbound traffic.

The system will help relieve traffic congestion by allowing drivers to change routes to less congested facilities. This will save travel time and free up congested corridors downstream from the sign.

Secure New Transit Service Hours

This project will provide funding to King County Metro to increase transit services in affected travel corridors (e.g., West Seattle, Burien, White Center, Ballard/Uptown, and Aurora Avenue) and support schedule maintenance requirements. The service hours and funding provided by the AWVSRP would cease after project completion.

Additional buses and service hours will help King County Metro maintain service schedules and provide additional seat capacity. This will help encourage mode shift (single-occupancy vehicles to transit) and reduce vehicle demand in the SR 99 corridor.

Bus Travel Time Monitoring System

This project will redeploy and augment the existing travel time monitoring equipment with limited new detection locations to cover key entry/exit points along downtown corridors. It will provide a means for monitoring bus performance to adjust to changes to street LOS during project construction. This project will also provide the valuable data needed for before-and-after studies to help maximize transit investments and will help transit agencies adapt service to meet customer needs.

I-5 Active Traffic Management

This project will deploy the Active Traffic Management techniques of speed harmonization and queue warning to northbound I-5 from Boeing Access Road to I-90 and perhaps SR 520. Speed harmonization and queue warning systems help dynamically and automatically reduce speed limits approaching areas of congestion, accidents, or special events. This helps reduce the number and/or severity of incidents.

Ballard and SODO Arterial Travel Time System

This project will generate arterial travel time information in the SODO and Ballard/Magnolia/Interbay areas by deploying license plate reader technology on key roadway segments. Traffic engineers will also use this information to optimize traffic signal operations to maximize traffic flow on congested streets. Travel time information will enable people and businesses to make informed decisions about their trip-making.

License plate reader technology to gather arterial street travel time data will likely be deployed in the 15th Avenue W. corridor serving the Ballard/Interbay corridor. In the SODO area, readers will likely be deployed on First Avenue S., Airport Way S., and Fourth Avenue S. from Boeing Access Road to S. Royal Brougham Way (SR 519).

Denny Way Corridor Improvements (ITS)

This project will optimize the traffic flow on Denny Way by restricting left turns at selected intersections, adjusting signal timing, and adding a new transit-activated signal at Third Avenue and Denny Way.

South End Transportation Demand Management (TDM)

This project will deploy TDM programs targeted toward serving commuter markets in the south end (primarily West Seattle, Burien, and Tukwila) and

trips destined to the SODO/Duwamish industrial area. Although final detailed project descriptions are being developed, these programs would likely focus on providing improved access to multimodal traveler information, and marketing to encourage the use of transit and carpool and vanpool programs.

Downtown Transportation Demand Management

This project will deploy TDM programs to reduce single-occupancy vehicle demand to and from downtown Seattle. Although final detailed project descriptions are being developed, these programs will likely target downtown retail and commercial travel markets, stadium and special events, and the integration of transit services with the Seattle Ferry Terminal. Additionally, this effort would include downtown parking management and strategies to shift long-term monthly parkers to other modes, opening up spaces for building owners and parking operators to provide as short-term parking.

In-Construction Adaptation Project

To meet an unforeseen mitigation need, this project will provide funding to target implementation of a project (or program), or supplement funding for one of the existing SR 99/Viaduct Project Initial Transit Enhancements and Other Improvements.

6.3.2 Other Mitigation Projects

Construction traffic mitigation projects will continue to be developed, with the goal of having critical projects in place by the time major construction effects to SR 99 traffic occur.

Although not part of the SR 99/Viaduct Project Initial Transit Enhancements and Other Improvements, the SR 99 ITS Project will implement travel time data collection and messaging, expand communications and improve traffic operations along and near SR 99. The project area extends from N. 145th Street to S. 112th Street. This project is scheduled to be operational by the time Battery Street Tunnel-related construction begins.

In addition to the SR 99/Viaduct Project Initial Transit Enhancements and Other Improvements, more localized mitigation measures will be developed as construction details are refined. Additional detail on mitigation will be included in the transportation management plan. The transportation management plan would provide a set of strategies for managing the work zone impacts of the project and address work operations, worker safety, traffic safety, appropriate traffic control, and traffic delay, movements, and access. Access to businesses would be maintained throughout construction. Localized construction mitigation measures specific to this Project could include the following measures:

- Signal timing adjustments for the ramp termini intersections at Seneca Street and Western Avenue would help mitigate the effects of the additional volumes by adding lane capacity to accommodate detour traffic on these ramps.
- Signal timing improvements and potential channelization revisions at the Broad Street and Denny Way off-ramps would help accommodate additional ramp traffic.
- A possible mitigation measure for the intersection of the Denny Way/SR 99 northbound on-ramp would be to eliminate the southbound left turns from SR 99 to Denny Way. This traffic could be redirected southbound across Denny Way, then back to locations east through a series of right turns.
- Provisions to modify signal timings at key detour route intersections in Belltown, such as at Fifth Avenue/Battery Street, and opportunities to rechannelize certain arterials to add detour capacity are recommended as mitigation to best accommodate increases in traffic volumes and associated congestion along key arterials. Changes in signal timing would need to be coordinated with and approved by SDOT prior to implementation. Intersections under consideration would include locations along the primary detour routes, such as Western Avenue, Elliott Avenue, and Battery Street. The additional capacity would be achieved through parking restrictions and/or lane striping changes. These modifications would allow for greater throughput along the targeted detour paths.
- Measures related to signal timing enhancements and parking restrictions would be needed on Battery Street to ensure that detour traffic is reasonably accommodated, especially for northbound detours during weekend closures.
- Coordination with Metro Transit in advance of work on Battery Street would be needed to help minimize disruptions to bus service. In particular, sufficient advance coordination would be necessary to allow Metro Transit to assess the need to run diesel coaches on any affected electric trolley routes.
- Measures such as increased signage and warning lights at the pedestrian crossings of the SR 99 northbound off-ramp to Western Avenue and the southbound on-ramp from Elliott Avenue may be considered to improve pedestrian safety.

6.3.3 Mitigation for Traffic Effects During Events

The project team is continuing to consider measures that would avoid or minimize closures of SR 99 during events. The Contract Provisions will likely specify that no closures will occur during major event weekends such as Bumbershoot and the Northwest Folklife Festival, and for all Seahawks home games. Coordination between WSDOT and SDOT is ongoing to seek ways to avoid or minimize closures for other critical periods, such as Mariners games and events at the Seattle Center.

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Chapter 7 INDIRECT AND CUMULATIVE EFFECTS

Indirect effects are effects that are caused by the Project but occur later in time or are farther removed in distance. Cumulative effects are effects that could result when relatively minor independent effects from multiple projects become collectively substantial over time if not properly mitigated. This chapter discusses both types of effects.

7.1 Operational Effects

This indirect and cumulative effects evaluation includes those transportation improvements expected to be operational by the Project's completion, which is anticipated to be late spring of 2011. The new transportation system components anticipated to be in operation include:

- Sound Transit Link Light Rail – Central Link is expected to be operational from Sea-Tac Airport to Westlake Station (in downtown Seattle) by 2010, with joint bus operations in the Downtown Seattle Transit Tunnel.
- Downtown Seattle Transit Corridor – This includes Third Avenue transit exclusivity (Stewart Street to Yesler Way); Prefontaine Place S. Reconfiguration; and a Fourth Avenue S. Bus Island north of S. Jackson Street.
- PSRC Four-County Assumptions – These travel demand model assumptions include PSRC growth/land use assumptions and regional transit and highway/roadway improvements. This information is based on the current Metropolitan Transportation Plan (Destination 2030) (as adopted).
- Transit Agency Six-Year Plans – Other regional capital projects include park-and-ride expansions, direct access facilities, in-line stop facilities, HOV lane construction, and other operational roadway improvements.
- King County Metro Transit Now Service Changes and RapidRide Corridors – King County Metro's Transit Now, a transit funding plan for service improvements that will substantially improve transit's ability to accommodate increased ridership. This plan includes RapidRide services that provide high-frequency service and bus priority improvements to highly traveled routes within King County Metro's service area. It also includes improved service on high-ridership routes and new peak and midday service in newly developing residential areas, and creates service partnerships with

major employers throughout the region. Transit Now has been included in the operating assumptions for the baseline conditions.

- SR 519 Intermodal Access Project Phase 2 – This project will connect a westbound off-ramp from I-5 and I-90 to the current S. Atlantic Street Overpass (S. Atlantic Street's current eastbound lanes would remain intact). Improvements at the intersections of First Avenue S./S. Atlantic Street and First Avenue S./Occidental Avenue S. will also be made. Additionally, a grade-separated crossing at S. Royal Brougham Way will be built to eliminate conflicts between cars and trains.
- S. Lander Street Overcrossing Project – A bridge structure would be built over the BNSF railroad tracks to touch down at First Avenue S. and Fourth Avenue S., ultimately providing a roadway that is no longer affected by railroad operations. (This project is not yet fully funded.)
- S. Spokane Street Viaduct Phase 1, Widening from SR 99 to First Avenue S. – Widening of the Spokane Street upper roadway.
- S. Spokane Street Viaduct Phase 3, Fourth Avenue S. Loop Ramp – A new eastbound loop ramp would touch down on Fourth Avenue S. south of S. Spokane Street.
- Home Plate Development – This project site is located west of First Avenue S. between S. Atlantic Street and S. Massachusetts Street. The proposed project would redevelop the entire site to include a mix of office, retail, and restaurant uses. The development would include approximately 300 event parking spaces and 500 accessory parking spaces.
- Port of Seattle Terminal 46, Increased Volume of Container Processing
- Port of Seattle Terminal 91 Cruise Ship Terminal Construction – The Port is moving the cruise ship terminal from Terminal 30 and constructing a new cruise ship facility at Terminal 91.
- Port of Seattle Terminal 30 Container Terminal – This project will convert Terminal 30's current use as a cruise terminal back to its original use for container operations.
- Mountains to Sound Greenway Pro-Parks Project – The Pro-Parks Project is working to plan and build the missing links in the Mountains to Sound Greenway. One of these links is the short piece between SR 519 and the beginning of the I-90 trail on Beacon Hill. This trail connection would link the Greenway from I-90 to the Seattle waterfront near the stadiums.

There are no anticipated long-term indirect or cumulative effects on transportation due to Project completion. It would not generate traffic and would improve safety conditions compared to leaving the existing facility in place.

7.2 Construction Effects

During the Project's construction phase (fall 2009 through spring 2011), several other projects are expected to be under construction in the downtown area and north of downtown. WSDOT and SDOT have been monitoring these projects' construction schedules and coordinating to avoid major construction conflicts and to minimize impacts to traffic to the extent practicable. Construction dates are subject to change, but notable projects that are likely to have construction schedules that coincide with or are close to the Project's construction schedule include:

- Bridging the Gap (2007 to 2013) – In November 2006, Seattle voters passed a \$365 million levy for transportation maintenance and improvements. Bridging the Gap will fund infrastructure maintenance and provide investment for major transportation projects. Considerable road and bridge repair work will take place throughout Seattle for a number of years. A Bridging the Gap project in the Belltown area includes Fourth Avenue pavement repair during the Project's construction period.
- Port of Seattle Terminal 25 (mid-2009 to mid-2010) – The south portion of Terminal 25 is going to be converted from cold storage warehouse use to container terminal operations.
- I-5 Pavement Repair (2009) – This will involve 22 lane miles of grinding and 58 panel replacements from Boeing Access Road to the King/Snohomish County line. Work will be done during evening and weekend closures of I-5.
- SR 99: S. Holgate Street to S. King Street Viaduct Replacement Project (2010 to 2013) – This project involves demolishing and replacing the SR 99 mainline from S. Holgate Street to the vicinity of S. King Street, with additional improvements from S. Walker to S. Holgate Streets. This project also would provide grade-separated access for freight and general-purpose traffic traveling between SR 519 (S. Royal Brougham Way and S. Atlantic Street), First Avenue S. and E. Marginal Way S., the BNSF railyard, and the Port of Seattle.
- Mercer Corridor Project – The Mercer Corridor Project would widen Mercer Street between I-5 and Dexter Avenue N. to accommodate three lanes of travel in each direction, parking, sidewalks, and a

median with left-turn lanes. Valley Street would be narrowed to a two-lane, two-way street. The construction schedule of this project is currently unknown, since it is not fully funded.

Overlapping construction schedules could have a cumulative effect on the project area. Together, these projects could intensify traffic congestion through downtown. This would cause problems for all drivers, including transit and freight.

Of particular concern are three projects that would occur during the same timeframe as the SR 99: Battery Street Tunnel Fire and Safety Improvements Project. One is the SR 99: S. Holgate Street to S. King Street Viaduct Replacement Project, another is the Fourth Avenue resurfacing, and the third is I-5 repaving.

The SR 99: S. Holgate Street to S. King Street Viaduct Replacement Project is scheduled to start in February 2010, with southbound SR 99 lane reductions beginning in January 2011. SR 99: Battery Street Tunnel Fire and Safety Improvements Project would be ongoing through the spring of 2011, so traffic restrictions due to construction of the two projects could overlap for 4 to 5 months. During this time, work on the Battery Street Tunnel would involve sporadic closures for painting, systems testing, and project closeout. Drivers on southbound SR 99 could experience disruptions both through the Battery Street Tunnel and on the viaduct (south of S. King Street) at the same time.

Fourth Avenue would be resurfaced from Stewart Street to Denny Way as part of Seattle's Bridging the Gap projects during March through September 2010. The road would be kept partially open to traffic during resurfacing work, but there would be construction activity occurring in proximity to the Battery Street Tunnel work.

Evening and/or weekend closures of sections of I-5 could be expected for I-5 pavement repair in 2009. The SR 99: Battery Street Tunnel Fire and Safety Improvements Project calls for weeknight and some weekend closures of SR 99 starting in fall 2009. If project schedules remain the same, it is possible that I-5 between about SR 520 and Spokane Street could experience some degree of closure during the same timeframe that SR 99 is closed through the Battery Street Tunnel in late 2009. However, coordination is ongoing to minimize or avoid overlapping closures of SR 99 and I-5.

The construction schedule for the Mercer Corridor Project is currently unknown, since the project is not fully funded. However, it is possible that this project (or some portion of it) may be built within the same period as the SR 99: Battery Street Tunnel Fire and Safety Improvements Project. The AWVSRP will continue to coordinate construction projects in the Belltown and South Lake Union area with the City of Seattle. As the Project's design

and construction planning move forward, project partners and other agencies will continue to work together to minimize possible cumulative effects and coordinate construction schedules.

Although coordination among agencies will continue and effective mitigation plans will be in place, the Project's cumulative effects relate to a larger area of effects (both beneficial and negative) than if it were the only major project under construction. The SR 99/Viaduct Project Initial Transit Enhancements and Other Improvements described in Section 6.3.1 would help improve conditions caused by cumulative effects.

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